3D TV: It's on the way . . .

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OCTOBER 2002
$6.60* INC GST NZ$7.50 INC GST
ISSN 1030-2662
PRINT POST APPROVED - PP255003/01272
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Contents

Vol.15, No.10; October 2002

SILICON CHIP

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FEATURES

4 3D TV In Your Own Home
You can watch 3D pictures via your computer or TV set but you're still going to need special glasses – by Barrie Smith

30 Electronics In Schools: The Class Of 2002
You won't believe some of the electronics projects the kids are making in school these days – by Ross Tester

32 6+ Megapixel SLR Cameras
How close do the new SLR digital cameras come to "film" quality? Canon's EOS D60 comes pretty close – by Ross Tester

65 Honda Fuel-Cell Vehicle Released In USA
No mass market plans yet but it's the first fuel-cell vehicle to receive government certification and hit the road

PROJECTS TO BUILD

14 Speed Controller For Universal Motors
Use it to control the speed of circular saws, routers, jig saws, electric drills and lawn edgers rated up to 1200W – by John Clarke

39 PC Parallel Port Wizard
This simple gizmo can test your PC's parallel port. It can also teach you a lot about the way parallel ports operate – by Trent Jackson

53 "Whistle & Point" Cable Tracer
Connect it to one end of a cable conductor and listen for the whistle at the other end and your wiring tracing problems are solved – by Jim Rowe

72 Build An AVR ISP Serial Programmer
It allows you to reprogram your AVR micro in a flash, without even removing it from the application circuit – by Stephen Davies & Peter Smith

SPECIAL COLUMNS

26 Circuit Notebook
(1) DC Automotive Tester With Current Probe; (2) Winter Charge Booster For 12V Car Batteries; (3) Triple-LED Version Of Torch; (4) One-Of-Nine Sequencer; (5) Simple AM Transmitter; (6) Battery Status Indicator; (7) Smoke Alarm Battery Life Extender

60 Serviceman's Log
Big TV sets can be a nightmare – by the TV Serviceman

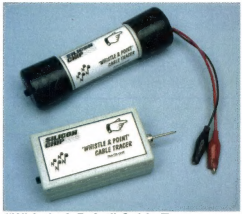
80 Vintage Radio
Radio Corporation WS122 army transceiver – by Rodney Champness

DEPARTMENTS

2 Publisher's Letter
10 Mailbag
59 Book Review
69 Product Showcase
79 Silicon Chip Weblink
88 Ask Silicon Chip
91 Notes & Errata
94 Market Centre
96 Advertising Index

Speed Controller For Universal Motors – Page 14.

PC Parallel Port Wizard – Page 39.



"Whistle & Point" Cable Tracer – Page 53.

Build An AVR ISP Serial Programmer – Page 72.

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Printing: Hannanprint, Noble Park, Victoria.

Distribution: Network Distribution Company.

Subscription rates: $69.50 per year in Australia. For overseas rates, see the subscription page in this issue.

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ISSN 1030-2662

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PUBLISHER'S LETTER

It's good news week, every week...

Do you get sick of all the doom and gloom constantly bombarding us? Are you sick of all the dumping on Australia by greenies and environmentalists concerning energy use, pollution, the Kyoto protocol, salinity, cutting of old-growth forests and a thousand and one other issues. This is not to mention the usual force-feed diet of crime, economic troubles, terrorism and whatever.

You could let all the media news get you down but a better approach is to think how much better off most people are than they were five, ten and 20 years ago. Or go back further. How much better off are you now than you were 30, 40 or 50 years ago? OK, you were younger (and possibly in better health) but by and large, life is better now than even in the recent past.

In general, with the possible exception of housing and petrol, most things you can buy now are much cheaper than years ago. In particular, virtually all consumer goods and mass-produced items are a great deal cheaper and better than they were in the past. Not only do we have access to vastly better technology in virtually every aspect of life, we are better fed, better clothed and have better health services than we ever had in the past. Our prospects for longer and healthier lives are also far better than in the past, in spite of concerns about pollution, growing ineffectiveness of antibiotics, mad cow disease and a host of other factors.

Why are we so much better off? Mainly it is due to the overwhelming advances in science and technology in every field of human endeavour. And we are especially lucky in Australia to be living in a rich country with access to virtually any product or technology we desire. Australia's economy has grown by leaps and bounds over the last ten years or so and the vast majority of Australians are reaping the benefits.

I like to think of the Australian economy as akin to a huge amplifier system with multiple inputs and outputs. The inputs come from all of us, government, business and a host of organisations. The outputs go to all of us as well but the outputs are unnecessarily "loaded down" by government taxes and excises, tariffs, surcharges and subsidies. There are filters in the system too, stopping both good and bad ideas from being implemented and there are "propagation delays" as well, causing desired government actions to be delayed, sometimes for years. There are multiple feedback loops as well, constantly correcting and modifying the "amplifier" behaviour and generally responding to the wishes of the majority.

There is nothing new in this thinking – economists have been using similar terminology in their computer models of the economy for many years.

So next time you are confronted by media doom and gloom, think about how well the Australian economic "amplifier" is running. Focus on the good.

Comet chasing has its ups and downs

It is was pretty frustrating, really. Our September issue featured a major story on NASA's comet-chasing satellites. But even before the issue went on sale, NASA was forced to make an announcement that they had lost the CONTOUR satellite which had just been launched. A replacement satellite is under way and the general theme of the story is unchanged but it was still frustrating for us. You win some, you lose some.

Leo Simpson

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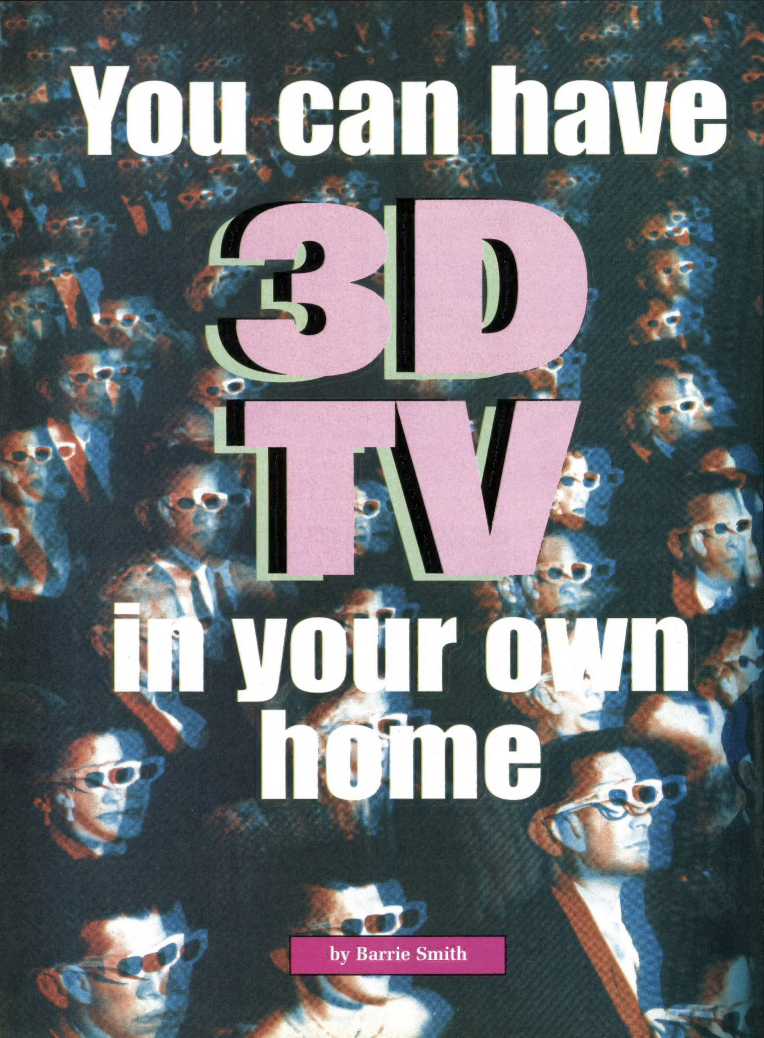
You can have 3D TV in your own home



by Barrie Smith

The third dimension. Has a certain ring to it, doesn't it? Creating images and viewing them in 3D is still a challenge, but this hasn't stopped video enthusiasts from punching out some corners of the envelope.

Most of us who can hear and see well, take binaural (stereo) sound and binocular vision for granted. Sophisticated devices to replicate the former experience have been around for 40 years or more and today we can enjoy the delights of Compact Discs in the home at little cost and even less fuss. Just sit back, fire up the hifi and listen; no need to sit in the 'sweet spot' of the room (unless you're a fanatic) and no pressing need for headphones.

But binocular vision, viewing images in stereo, enjoying the third dimension – that's a tougher call. And this is the odd thing: image capture by means of the photographic process has been around for 176 years now, while sound recording has been with us only 125 years since Edison began to market his phonograph.

Furthermore, it was only about 25 years after Niepce took the world's first photographic image that stereo cameras became practical devices and people of the Victorian era could sit back and enjoy images of their world in simulated depth, thanks to the Wheatstone hand-held viewer.

19th Century Apparatus

And there lies the rub: successful and satisfactory viewing of the 3D image always has, and still is, accomplished by use of a viewing aid to feed the eyes and brain discrete images, for the left and right eyes.

In the 19th century it was the Holmes-style viewer or similar hand-held apparatus.

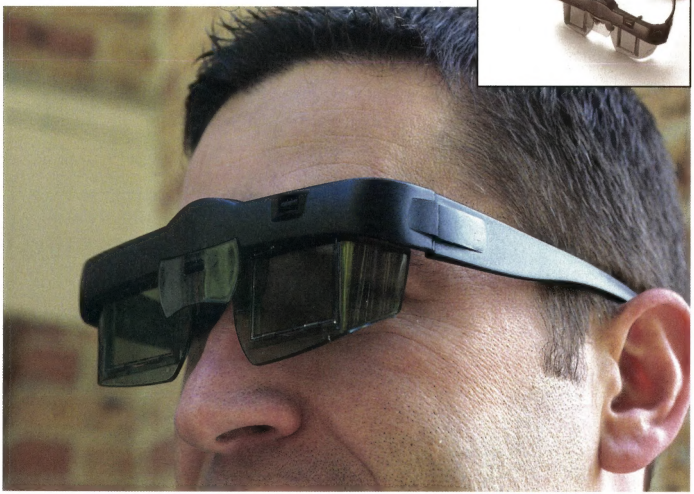
In the mid-20th century 3D viewing could be achieved with spectacles fitted with red and blue/green filters then, thanks to Dr Edwin Land's invention, cross oriented polarising filters.

Over time there have been no-specs, lenticular systems, as evident in commonly available 3D postcards and in a little known Russian projection system. Lenticular 3D has never really taken hold but may see some daylight in new LCD technology developments.

Stereo imaging, since its inception, has surged in popularity in fifty-year cycles.

The last bump on the 3D radar screen was in 1952, when the pioneering movie Bwana Devil premiered in Los Angeles on the Thanksgiving evening of 1952, bringing "screams from the audience" as a lion "leaped from a screen".

3D movies carried the burden of recapturing lost audiences infatu-



You can watch 3D pictures via your computer or TV set – but you're still going to need the glasses! Inset is the H3D spectacles and IR emitter.

We can't hope to do it justice in a printed magazine page but here's a frame from Ultimate G's 3D title. This is a single (left eye or right eye) image.

ated by commercial TV when it appeared in 1948.

Massive 3D

Today, you can visit your local IMAX theatre and enjoy a similar but far more vivid experience as the expansive film process runs a catalog of documentaries shot with a pair of massive 70mm motion picture cameras and shown with an even more massive pair of projectors.

The audience views the huge image with somewhat bulky and clumsy LCS (Liquid Crystal Shutter) spectacles, delivering a rapid sequence of right/left eye images, triggered by an infrared beam within the cinema.

Yes, we have come a long way! 3D movies – but we're still wearing glasses!

3D on DVD

Now, thanks to the popularity of DVD as a delivery medium, you can enjoy 3D viewing via your home TV set. And, if our pockets and energies can take us there, we can even craft our own 3D productions. But we'll still need to wear glasses to enjoy stereoscopic video!

However you have to remember there's 3D . . . and there's 3D!

For a few years now the computer gaming fraternity have been playing with highly enhanced 3D graphics on their PC screens, PlayStation consoles and the like.

But this is a graphic display that shows the three dimensions – width, height and depth – rendered as a flat image, in other words as a perspective illustration.

Then there's the 3D process, the topic of this story, which displays graphics as a binocular image, with each eye receiving a discrete image. Without a viewing aid, such as dedicated spectacles, the image is a confusion of two slightly displaced images.

However, when the viewer dons the specs, all is revealed and the illusion of the image having true width, height and depth is achieved. You feel you can reach out and touch the subjects on screen.

Anaglyph Stereo

Despite the existence of a fat backlist of 3D movies dating back to the 1950s, the third dimension on TV is a comparative rarity.

I can well remember the excitement of one Friday night in October, 1983 when the Channel Seven network broadcast nearly two hours of 3D television. 3D on TV – at last.

The only downside was that you needed to wear a pair of anaglyph spectacles (left eye looks through a red filter, right eye uses blue/green) to enjoy the offering.

You could say the audience response was 'underwhelming' – and stereoscopic movies on TV never reappeared on Aussie screens. Perhaps the menu of a Three Stooges short and a low budget Western called Fort Ti was the reason.

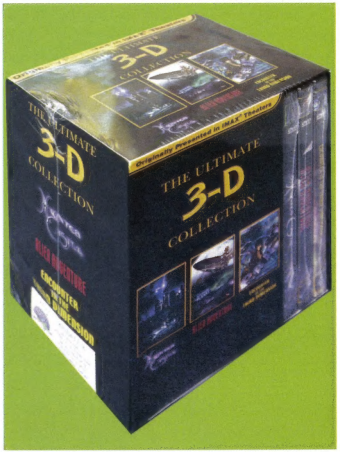
Viewing Session

To get a hands-on experience of 21st century 3D TV I spent the morning with Mark Giles of Mindflux, a Sydney company importing and distributing 3D gear. To get a 'second opinion' I took along this magazine's editor and publisher, Leo Simpson.

Mark very kindly took us through the ropes by first setting up a TV set and DVD player and handing each of us a pair of black specs with grey LCS lenses. The DVDs viewed (and generally available) are all NTSC productions, so you need a compatible player and TV set.

Mark then slipped a disc onto the player, Haunted Castle, a title which I had previously seen and been impressed by, in the Sydney IMAX theatre as a 3D presentation.

The show is a feast of impressive computer imagery that



The Ultimate 3D Collection contains a decoder, 3D specs and DVDs.

takes you through haunted castles and the like - and ends with the obligatory and fairly scary roller-coaster ride.

The stereoscopic effect in this presentation is excellent with the 3D effect convincing and not at all an eye strain. I said the roller coaster ride was 'fairly scary'.

Well, to be honest, the scare factor (SF) is directly proportional to the screen size.

In the IMAX theatre it was a blast! However, our preview session was run with a 50cm television set so the SF was many notches down from the 30 x 38 metre IMAX mega screen. But it was not hard to imagine the effect from a largish (say a metre or more diagonal) rear projection or front projection television set up.

Next up was Ultimate G's, a more 'down home' sort of production about two kids' dream of becoming pilots, mixed in with some stunt flying. This gained much because it was nearly all shot in 'true' (not CGI simulated) live action, with real people in real environments.

The production had been carefully photographed and the 3D effect was again convincing and enjoyable but a little more exaggerated than the first film, although not enough to cause eyestrain.

It should be noted that both these productions (and possibly most other 3D titles) are packaged on the same DVD as 2D and 3D versions.

The 3D video signal consists of alternating left and right images – alternating at the field rate of the video signal (50Hz for PAL and 60Hz for NTSC). The LCS 3D glasses contain shutters that alternately block each eye so that the left eye only sees left images and the right eye only sees right images. When the glasses are taken off, you can see both images overlaid.

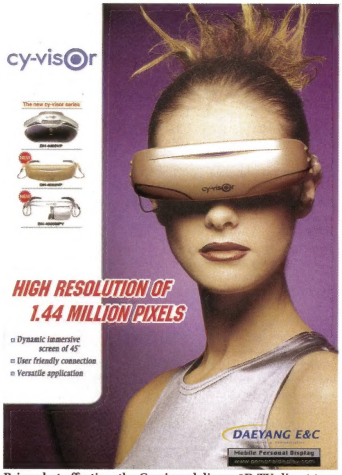
Depending on the offset between the two images, it can range from blurred to utterly unwatchable.

In both cases, any scene with bright areas – such as sky – revealed quite noticeable flicker; it is possible to alleviate the flicker by careful adjustment of contrast.

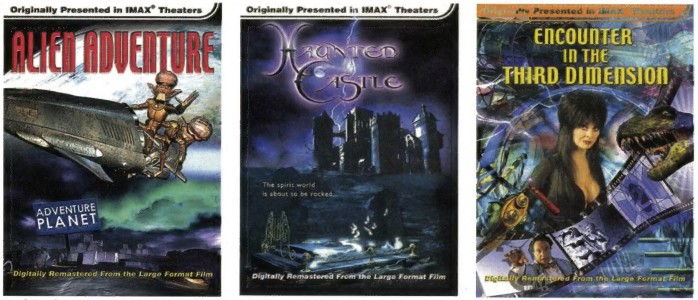
With specs off you see a double image. It was interesting to hold a freeze frame on the DVD and see a clear, non-stereo image, intended for a single eye.

'Freeze frame' should really be called 'freeze field' as some devices (from TVs, to VCRs, camcorders and DVDs) offer a 'Pause' function which holds only a single interlaced field.

This factor is, of course, the heart of the whole system. 25 of the fields (in PAL) in any one second carry the left eye image; the other 25 carry the right eye image. So the video



Pricey but effective, the Cy-visor delivers 3D TV direct to the spectacles' LCD screens.



Looking for some 3D DVD Titles? Here's just a few, originally shot for the huge IMAX format and now reduced somewhat!

The Standard

NTSC and PAL can both be used for the recording and playback of stereoscopic 3D video by storing the left and right views in the even and odd fields of the video signal. This is commonly known as "field-sequential 3D video" or occasionally "alternate-field 3D video". However, the choice of which image (left or right) to store in which field (even or odd) is arbitrary.

A proposed standard is in development that seeks to formalise the image/field polarity for the recording of field-sequential 3D video in the NTSC and PAL standards.

picture of 25 complete frames in each second is comprised of two sets of 25 interlaced 'lefts' and 'rights'.

The 3D programming on the DVD is accomplished by coding the left and right images onto the even and odd fields respectively (or vice versa).

A standard sync extractor chip (eg, LM1881 or EL4581) can be used to identify odd and even fields and hence identify left and right images. The LCS glasses are then driven by this signal.

On replay, an IR emitter transmits to the infrared viewing spectacles in the room (a maximum 'live' viewing screen-to-specs distance of six metres is quoted by Mindflux).

A tiny IR receptor is built into the front of each spectacle frame; at this point the infrared signal fires the opacity/transparency cycle of the specs' LCS lenses; the left eye sees only the left image, the right eye sees only the right.

Mindflux markets a variety of 3D TV packs. One is the Ultimate 3D collection ($229), containing three DVDs, the H3D signal box (connected to the DVD's output and mountable on the top of the TV set) and two pairs of wired LCS spectacles.

If you hanker for total viewing freedom you can purchase two pairs of wireless specs (H3D Video Eyewear) and enjoy a far more comfortable viewing option, for an additional $235.

There is also a computer pack (Eyeforce), suitable for

Another 3D viewing option: i-glasses!

installation on your Windows PC. Similar setup: a different IR emitter (which sits on top of your monitor) and two pairs of specs. Cost: $249.

There are other spectacle options, including head-mounted displays (HMD) – Cy-visor is one at $3699 — which plug directly into the DVD's video output or the computer's VGA signal. These are equipped with a pair of LCD screens and of course need no TV set to create the stereoscopic image.

And this is where the story gets interesting: Mark ran a DVD computer game, authored in stereo, on a Windows PC, with the monitor set at a refresh rate of 100Hz.

Voila! No flicker. My guess is that you could probably run the 3D programming on most screens, even with refresh rates down to as low as 70Hz and enjoy the 3D effect with zero flicker.

The point is, you don't need more than 25 fields to create the stereo image, but you do need more than 25 'bursts' of an on screen image to avoid flicker. That is, each of the 25 fields shown each second can be displayed on screen for a frequency of more than 1:1.

Eyeforce 3D pack, with wireless spectacles.

100Hz scan rate

So why not run the show on a 100Hz television set to overcome flicker? (Or 120Hz on an NTSC model?) Good idea.

But it doesn't work! For a 100Hz set to work with 3D, the left-image, right- image,

Footnote

Andrew Woods suggests that readers can view his conference paper from 1991 "which discusses the principles I used to modify the components of a Grundig 100Hz TV set to achieve 100Hz 3D."
Go to: "The use of flicker free television products for stereoscopic display applications" at http://info.curtin.edu.au/~iwoodsa

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left-image, right-image field sequence (ie, L1 , R1, L2, R2 etc) needs to be maintained.

Unfortunately most 100Hz sets don't do this; most implement a modified field sequence that regrettably upsets the 3D content. Some TVs interpolate new fields to improve depiction of 2D motion at 100Hz.

Other sets merge the odd and even fields into a single progressively displayed frame, then use a rapid cycle frame store to deliver a double quantity of the complete frames. So there is a range of methods used.

For a 100Hz set to work with 3D it needs to convert the 50Hz PAL signal field sequence from the normal sequence of L1, R1, L2, R2, L3, R3, to a "doubled up" sequence of L1, R1, L1, R1, L2, R2, L2, R2, L3, R3, L3, R3 at 100Hz.

It's not that scary . . . honest!

This is a relatively simple scheme to implement (simpler than some of the 2D schemes) but most 100Hz TV sets don't offer it – although some can be modified to achieve it. A secondary issue would be how to sync the LCS glasses with the 100Hz signal.

There is considerable debate in 3D TV circles as to methods of tapping into 100Hz display systems to deliver high quality, flickerless stereo images. Dedicated TVs and converters are available in the US and Europe; the URLs are www.3dmagic.com/catalog/price_list/price_list.html#TV and www.micronas.com/press/pressrel-eases/pressrelease.php?s=1&ID=171

Next issue: we take a look at some of the DVD titles and apparatus available in Australia – plus a hands-on trial of a 3D camera adaptor that lets you shoot 3D video with a consumer camcorder. **SC**

Acknowledgement:

Barrie Smith would like to thank Jason Pang and Mark Giles at Mindflux for their help as well as to express his gratitude to Andrew Woods at the Centre for Marine Science and Technology, Curtin University of Technology, Perth WA for additional technical advice and checking.

Low Cost PC-Based Instruments Low Cost PC-Based Instruments Low Cost PC-Based Instruments

DrDAQ - Multi Sensor Data Logger

- Built-in Sensors for Light, Sound & Temperature
- Measures pH - just plug in a standard electrode
- Ideal for Science Data Acquisition & Logging Experiments

Simply plug DrDAQ into the parallel port of any PC, run the supplied PicoScope and PicoLog software and you are ready to collect and display data. DrDAQ uses power from the PC so no batteries are required.

DrDAQ
$217 inc GST

Specifications

- Built-in Sensors: Sound Waveform, Sound Level, Voltage, Resistance, Temperature, Light
- Two External sensor sockets
- 1 TTL and 1 LED Digital Output
- Connects to Parallel Port
- Overload protection ±20V
- Extensive library of science experiments

ADC-100 Low Cost PC Based Oscilloscope

- 12 Bit Resolution, Dual Channel
- Plugs Into PCs Parallel Port
- Ideal for Audio & Automotive Electronics

The ADC-100 is a dual channel, 100kS/s oscilloscope, spectrum analyser, voltmeter and frequency meter. Very useful as a general purpose instrument in the field or in the lab.

ADC-100
$827 inc GST

Specifications

- Resolution 12 Bits
- Channels 2 x BNC
- Analog Bandwidth 50kHz
- Sampling Rate 100kS/s
- Voltage Ranges ±50mV to ±20V in 9 ranges
- Scope Timebases 100us/div to 50s/div

ADC-200 PC Based Oscilloscopes

- 8, 12 & 16 Bit Resolution
- Oscilloscope, Spectrum Analyser, Volt & Frequency Meter, XY Scope and Logging Software Included
- Fraction of the Cost of Comparable Benchtop Instruments

The ADC-200 series offer a combination of high speed and high resolution models, with deep memory and advanced trigger functions.

For example the ADC-200 high speed models are ideal for microcontroller and digital circuit applications while the ADC-212 and ADC-216 high resolution models are ideal for monitoring sensors, transducers, vibrations, noise and audio signals.

Units plug into the PCs parallel port and are supplied with PicoScope and PicoLog software.

Priced From
$1,065 inc GST

Product	Sampling Rate	Analog Bandwidth
8 Bit Series		
ADC-200/20	20MS/s	10MHz
ADC-200/50	50MS/s	25MHz
ADC-200/100	100MS/s	50MHz
12 Bit Series		
ADC-212/3	3MS/s	1.5MHz
ADC-212/50	50MS/s	25MHz
ADC-212/100	100MS/s	50MHz
16 Bit Series		
ADC-216	333kS/s	166kHz

Emona Instruments Pty Ltd
Tel 1 800 632 953 Fax (02) 9550 1378
email: testinst@emona.com.au web: www.emona.com.au

Low Cost PC-Based Instruments Low Cost PC-Based Instruments Low Cost PC-Based Instruments

MAILBAG

Solar Panel Payback Period

I refer to the Mailbag item in your August 2002 issue "Are photovoltaic cells really green?" from a Glenn Mayall. Your correspondent once again repeats a myth, attributed to the Reagan era in the USA, namely that solar panels never generate enough energy to make up for that expended in their manufacture. There was a very detailed article on this in "Home Power" magazine January 2001. It is well worth reading both the article and some of the references.

Please, the time has come for you to take a stand and dispel this myth rather than repeat it in your magazine. Check the following article at http://www.humboldt1.com/~michael.welch/pvpayback.pdf

Ross Dannecker,
Rockhampton, Qld.

Project suggestion – a silent PC

I have a suggestion for a project: a silent personal computer, preferably in a small case. Even making the power supply fan-less would make a huge difference.

Don't you think it is about time PCs were like the rest of our home entertainment appliances, such as the VCR, DVD and hifi amplifiers, all quiet!

Peter Humphreys,
via email.

Comment: we like your idea but we don't see it happening anytime soon. These days even laptops have fans.

Service history for appliances is desirable

I refer to the note in SILICON CHIP January 2002, page 92, entitled "How to stop rust on screws". This reminded me of standard Service Radio & Radar gear which had red shellac anti-vibration sealer applied to screws etc. This is useful if a service or modification is carried out a different colour may be used to reseal, thus showing a "modification".

I used such method to seal screws in spectacle frames. The colour was easily visible – ensuring sealing had been done, unlike clear varnish which is hard to see.

Secondly, reading the "Serviceman's Log", surely it would be considerate for "repairers & technicians" to put a plate or "log" into the bowels of the equipment giving a precis of service/modification history. This is not new as watch and clock makers years ago recorded service by enscribing in the case of the object.

Finally, service records should record all tests performed with result, whether normal or abnormal. Memory is not a suitable repository of information.

John Ernest,
via email

Electrical wiring regulations in Queensland

I followed with some interest the debate last year regarding the introduction of new laws regarding who could work on mains powered equipment, particular in Queensland.

What has happened to these laws? Have they come into effect? If so does this mean only electricians can do upgrades to computers eg memory, hard disks etc?

Frank Krista
Gordon Park, Qld.

Comment: As noted in the editorial in our June 2002 issue, Queensland carried out a review of regulations and have maintained the status quo, ie, it is illegal for anyone to work on mains-powered equipment unless they have, at least, a restricted licence. Unfortunately, while we made a big effort to change this, there is just not enough interest from our readers or any other bodies (eg, electrical engineers) to make the politicians sit up and take notice. In this country, apparently Apathy does rule!

What's wrong with Basslink?

What on earth is your correspondent Keith Anderson, in his letter entitled "Basslink should be done properly" (August 2002), on about?

He claims Basslink is being done badly, why? He does not say.

The proposed technology for Basslink is conventional state of the art. It is not the only choice but it is a perfectly reasonable and defensible choice.

If Keith Anderson has a valid point to about Basslink why doesn't he make it?

Graham Shepherd,
New Town, Tas.

Critical components hard to get

On quite a few occasions I am keen to construct one of the projects detailed in your magazine but am frustrated by the time taken in sourcing one or two critical components. A case in point is the PC IR Transceiver published in the December 2001 issue. The critical component the SMT transceiver itself described as TFDS4500 by Vishay Telefunken.

I presume this is the Manufacturer (German?). Some direction in sourcing this component within Australia would be appreciated. RS stock a similar device with a different pinout while Farnell don't seem to carry anything in this line at all. Would appreciate any help.

Ross Metcalf,
via email.

Comment: We often have this component sourcing dilemma and it is usually because the component concerned is not available in small quantities from the local distributor or often not available at all from the local people because they just cannot be bothered. The project is available as a kit from Jaycar.

RDS in Australia

After owning a home stereo and car stereo with RDS (Radio Data System) capability I started to wonder why only Triple J was transmitting the RDS

information, so I decided to do some research.

After talking to a number of broadcasters I found out that the main reason was that they believed there weren't enough RDS receivers out there. I checked out a few places that sell both car and home stereos, and found that not every second stereo sold had RDS, but still quiet a few did. Many manufactures don't bring there RDS models in to Australia because not enough stations are broadcasting RDS.

So it's sort of a stalemate between broadcasters and stereo receiver manufacturers. It would cost an outlay of less than $3000 for a broadcaster to transmit RDS, and for that their name would be advertised on a lot of people's radios.

In order to gather information on the numbers of RDS receivers, to show broadcasters that it would be worthwhile transmitting the RDS signal, I decided to set up a web page. If you would like to see more broadcasters use RDS, please add your RDS receiver to my page as well as any other stations you know which are transmitting RDS. www.sutcliffetech.com.au/rdsinfo.html or email: rdsinfo@sutcliffetech.com.au.

Gary Sutcliffe
Brisbane, QLD

Amateur radio articles wanted

What a wonderful opportunity you have now with the demise of Electronics Australia and Radio Mag. It would be a pity to waste such an opportunity, to incorporate the diversity of subjects that these two magazines offered, in SILICON CHIP.

I occasionally purchase SILICON CHIP from our local newsagent but find there are limited articles that suit my interest, with the exception of Vintage Radio. If you could incorporate articles on Short Wave and Broadcast-

Huge Santa Display panel

Here are the specs for the Santa Display (SILICON CHIP, November 2000) we made when we found ourselves with a couple of weeks to spare.

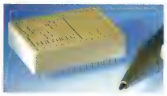
Four long days to make and paint, nine hours and one carton to drill the first 1254 holes and the slight chamfer to every hole at its face (looks better), seven 10-hour days to wire using 700 metres of cable and tinned wire. The panel was 3.6 x 1.8 metres. All this is still only driven with the original PC board and one transformer, which still only got warm. Cost excluding the LED stars was $710:00.

We first decided on stars after the rest was done and working, as the background looked a bit bare and with blue and white LEDs costing around $5 a throw, four should have done it but my better half chose the position from the front as I drilled from the back – that's the four white LEDs near Rudolph. That looked too symmetrical so I decided to buy 8 more, 4 white and 4 blue. I could only get 3mm blue at the time (a few bucks cheaper but just as bright as 5mm).

I have saved a few dollars towards this coming year's project. At this stage it looks like I will be using 200 blue LEDs and two of your "flickering flame" PC boards to make an 8-pointed star 2.2 metres high and 1.2 metres across that will twinkle way up high on the roof.

Dallas Redding,
via email.

The Tiger comes to Australia



The BASIC, Tiny and Economy Tigers are sold in Australia by JED, with W98/NT software and local single board systems.

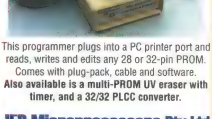
Tigers are modules running true compiled multitasking BASIC in a 16/32 bit core, with typically 512K bytes of FLASH (program and data) memory and 32/128/512 K bytes of RAM. The **Tiny Tiger** has four, 10 bit analog ins, lots of digital I/O, two UARTs, SPI, I²C, 1-wire, RTC and has low cost W98/NT compile, debug and download software.

JED makes four Australian boards with up to 64 screw-terminal I/O, more UARTs & LCD/keyboard support. See JED's www site for data.

Intelligent RS232 to RS485 Converter

The JED 995X is an opto-isolated standards converter for 2/4 wire RS422/485 networks. It has a built-in microprocessor controlling TX-ON, fixing Windows timing problems of PCs using RTS line control. Several models available, inc. a new DIN rail mounting unit. JED995X: $160+gst. Www.jedmicro.com.au/RS485.htm

$330 PC-PROM Programmer



This programmer plugs into a PC printer port and reads, writes and edits any 28 or 32-pin PROM. Comes with plug-pack, cable and software. **Also available is a multi-PROM UV eraser with timer, and a 32/32 PLCC converter.**

JED Microprocessors Pty Ltd
173 Boronia Rd, Boronia Vic 3155
Ph. 03 9762 3588 Fax 03 9762 5499
www.jedmicro.com.au

ing Band DX-ing, Amateur Radio, also possibly offer limited free advertising, I am sure you would increase your sales volume no end.

Other topics I am sure would be of interest to the vast majority of your audience would be articles on amateur radio, such as antenna tuners, VSWR meter, RFDS frequencies, aerodrome NDB frequencies and locations, new marine frequencies and locations of marine HF stations, antenna topics and so on.

I respect SILICON CHIP for what it offers, however, I am positive if you offered these subjects, or at least undertake a feasibility study on same you would be very pleasantly surprised.

G. J. Wilson,
Mt. Seymour, Tas.

Comment: While we appreciate that you would enjoy articles on Shortwave, DX-ing and the other topics, we have had little indication of reader interest in these subjects in the past. Are other readers keen to see these sorts of articles?

Cordless phones link for modems

Is it possible to adapt a cordless phone to access the internet over a reasonable distance, say 100 to 150 metres and at say reasonable speed, if not at the usual 56k.

IBM did have some interface with some clever electronics but ceased manufacture in 1998, it was called "The IBM Cordless Computer Connection".

It would make a nice project, to circumvent the usual umbilical cord we have to live with, and to save the expense of mobile phone gizmos.

Bill Mulders,
via email.

Comment: This is a great project idea but we would have to standardise on a particular cordless phone for any design work.

In appreciation of the Airzone 500

The July article on the "Airzone 500 series" gave me many a wry smile. I had one of these once in 1954. I picked it up off the tip at Willoughby; amazing to recall what was thrown out in those days. However, the series entered my life again round 1980. A friend's parents were given such a set (mantel identical with the one shown on the photos) as a wedding present. It had been stored for many years in their linen cupboard until they gave it to their son, a friend of mine.

It eventually "carked" it in 1980. He asked me to look at it for him and I found the mains transformer was burnt out. Even then, the prospect of securing a replacement was daunting and he rather baulked at having it rewound due to the cost. I told him I'd keep my eye open for one and when I was visiting a friend in Newcastle, asked him if he knew of any "junk shops" where such things might turn up. He mentioned one place on the outskirts so I drove and asked the proprietor. "No", he couldn't assist, but he thought that a chap at Charlestown probably could and gave me the address.

I called in there on my way back to Sydney. The house was a fairly small fibro dwelling, but was almost hidden from view by a mountain of rusted out whitegoods.

I knocked on the door and got no answer. There was pathway down the yard and I could see a shed at the rear with the door ajar. So thinking the owner might be fiddling in his shed, I ventured down and knocked on the shed door. No answer. I peered round the door and as my eyes adjusted to the gloom, I saw something which produced a reaction of mixed shock, amazement and joy.

There before my eyes, stacked floor to ceiling were dozens of radios from the 1920s and early 30s. It was an absolute "Aladdin's cave" of old radios.

I must say that my immediate reaction was promptly followed by a mixture of guilt, occasioned by envy and I thought it best to beat a retreat before the owner turned up in case he got the wrong idea. I turned to go and as I went to close the door to I found it wouldn't shut.

I glanced down to see what was blocking it and to my sheer amazement, there was a power transformer complete with tagstrip, covered in dirt and dust. I picked it up and rubbing the dust off the tagstrip, I saw from the voltages and ratings that it was exactly what I was looking for. What should I do?

I debated waiting for the owner, then telling myself that if he used a transformer where he could use half a house brick, he didn't see the transformer of any value. So I decided to "buy" it.

I took it out to the car where I wrote a note explaining what I'd done and stuck a $5 bill in it and put it under the front door. I left feeling rather guilty. I cleaned it up, checked the voltages and found it OK, removed the tagstrip, installed "flying" leads and mounted it on the Airzone.

About six weeks later I was in Newcastle again and plucking up the courage to visit the house at Charlestown, I drove down the street looking for the house with the white-goods.

I couldn't find the house matching that description but judging from its approximate position, the bare earth and the fresh coat of paint on the house, I pulled up outside the place. There were two young fellows leaning on the bonnet of a "souped-up" Cortina, tinkering with the innards.

I approached them and saying I thought I had the house right, describing my earlier visit, was informed that "the old bloke" had died. "What happened to all the old radio stuff down in the back shed?" I asked. "All that old junk went to the tip mate," I was informed. I left in sorrow.

Richard Lockhart,
Artarmon NSW.

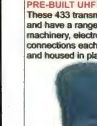
Comment: we have published this rather long letter as a cautionary tale. If you have a big collection of "valuable" stuff, don't let it be disposed of in this way after your demise. Sort it, catalog it, sell it or give it away but don't let it be sent to the tip! **SC**

NEW 2km SUPER 433mHZ UHF TRANSMITTER AND RECEIVER SETS

We have not seen legal 433Mhz transmitters with this much range before !!!

PRE-BUILT UHF RX's & TX's

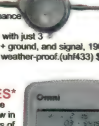
These 433 transmitter and receiver sets are pre-tuned for maximum performance and have a range of up to 1.8K. They would be ideal for remote control of machinery, electronic equipment etc. Simple to connect to other projects etc with just 3 connections each, transmitter 12VDC + ground and signal... receiver 5VDC + ground, and signal, 190mm long and housed in plastic case with built in antenna. They could easily be made weather-proof.(uhf433) $55 pair



NEW*NEW*NEW

PHONES*PHONES*PHONES

Where else can you get a cordless phone at this price? All of the these items are new in their original packaging. Why pay hundreds of dollars for a quality cordless phone?

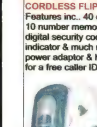


OMNI CA390 Caller ID Unit

See who is calling be for you answer. Features include compact size, clear LCD display & 70 memories. $12 ea. (ca390)

OMNI ELITE 2.4Ghz CORDLESS FLIP PHONE

Features inc. 40 channels, auto answer, 10 number memory, handset, 2 way digital security code, out of range indicator & much more. Comes with power adaptor & handset battery. Ask for a free caller ID unit with this phone.



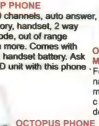
OCTOPUS PHONE

Modern styling, wall or desk mount. Why pay rental to your phone company. Own one

FOR JUST $12 (octo8)

OMNI CL100 Call screener Memory Phone

Features include Displays caller's name, number, time / date, 70 ID memories, control, hearing aid compatible and wall or desk mount. (CL100) $55 ea.



MOBILE PHONE ACCESSORIES PACK

Give your NOKIA 8210 a new look.

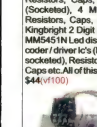
This kit includes hands free, car charger and zip up splash-proof bag. **For less than the cost of the face. $11** (noc8210)

NEW, OLD AND NEAR OBSOLETE SEMICONDUCTORS

GO TO OUR WEB SITE AND CLICK ON THE "**LOTS OF SEMI'S**" LINK & VIEW THE EVER GROWING LIST OF NEW, HARD TO FIND, OBSOLETE AND NEAR OBSOLETE SEMICONDUCTORS WE HAVE IN STOCK.

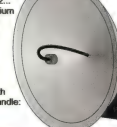
FRYER CONTROLLER

These could be used intact or connected to a PC to control the 4 high current outputs on the PCB (Schematic for the output section supplied)These items are full of This amazing parabolic microphone can listen in on all useful bits like..Sprecher & Shun Contactor CA-9-10 sorts of things from a distance, like bird calls and made in Switzerland. (New cost $90), 15va 240v wildlife sounds, etc. Or by attaching the microphone to Transformer 0/6.3/7.5/8.5/9.5/12.5/15 secondary, Pcb a metal rod or screwdriver handle it can be used to 170mm x 140mm containing : 5 off H100S12-1-C listen to white Ants chewing on your house! It is also Millionspot Relay, 5 off Diode bridge 1 Amp, 2 off Diode ideal for detecting engine knocks and worn bearings bridge 5 Amp, 4 off High current Triacs. TPDV1240, 5 off etc. We even heard water rushing through a radiator Opto isolator 4N25, 4 off 440 Volt AC 0.047 caps, 1 off hose! Kit inc. PCB, all onboard components, Mains power switch (Rocker style), 12 way terminal block stethoscope pickup, (32 Amp ?), 1 off 16 way IDC connector, Various electret Microphone. Resistors, Caps, Regulator etc. Zilog Z86E2304PSC KIT (K175) $22... (Socketed), 4 Mhz XtL High power Piezo sounder, 300mm Aluminium Resistors, Caps, Ic's Regulator etc. Display Pcb. 4 off Parabolic Dish: Kingbright 2 Digit DA56-11EWA 7 seg led displays. 2 off (K175D) $18... MM5451N Led display de-coder / driver Ic's (NOT socketed), Resistors, Caps etc.All of this for just $44(vf100)



SOOPER SNOOPER

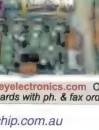
PARRABOLIC MICROPHONE/ STETHOSCOPE



Suitable small plastic Case: (HB1) $2.50... Power switch: $2.50... Long Screwdriver with Solid plastic Handle: $1

SPECIAL SOLAR FURNACE / PARABOLIC REFLECTOR

This is the same 300mm dish used in our Sooper Snooper. It is mill finished ie. unprotected aluminum & is reflective enough to ignite paper almost instantly, Some automotive cutting compound / polish it could make it highly reflective.$18 ea.



** LOOK****LOOK**

OUR NEW E-Mail address

To help speed up our response to your E-Mails we have introduced a new Oatley E-Mail address...techo@oatleyelectronics This address is for technical enquires only & our regular sales@oatleyelectronics address is now for sales enquiries only.

Series IV 4 CHANNEL UHF RECEIVER KIT: Combined with our Series IV Code Hopping TX (TX4), this RX kit can control 4 relays in any mix of toggling or momentary use. Uses a pre-built & pre-aligned 433MHz UHF (crystal locked) code hopping RX module. This RX module can learn up to 15 trans-mitters. The relays have high current contact ratings. 12V DC op-eration. Receiver kit inc. PCB & all on-board components.

(K180) $54

Series IV 4 CHANNEL UHF TRANSMITTER KIT:

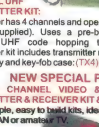
Transmitter has 4 channels and operates from 12V lighter battery (supplied). Uses a pre-built and pre-aligned 433MHz UHF code hopping transmitter module. Transmitter kit includes transmitter module, battery clips, 12V battery and key-fob case:(TX4)$25

NEW SPECIAL PRICE

2.4GHz 4 CHANNEL VIDEO & STEREO AUDIO TRANSMITTER & RECEIVER KIT & ANTENNA PLANS

These simple, easy to build kits, ideal or experimentation for radio LAN or amateur TV.

STEREO A/V TRANSMITTER / RECEIVER KIT:



This kit contains K171C & K171D modules & inc. PCBs voltage regulators & RCA connectors on the receiver **only$ all on-board parts.. (K171B) $99**

2.4 GHz VIDEO TRANSMITTER ANTENNA PLANS :

Check our website for plans to build a antenna made from a **"PRINGLES"** chip container to suit this kit. We tested one of these antennas fitted to the receiver only, we received great audio & video signal over a distance 500M

HIGH CURRENT POWER SUPPLY

20A+ SWITCHED MODE POWER SUPPLY: Ideal for stepper motors. This power supply is built using a surplus 48 - 24V DC to DC Converter & one of our new toroidal transformers. We sell the DC to DC Converter unit on it's own for $44. For an additional price, we supply a toroidal transformer, 35A bridge rectifier, 5 capacitors & instructions on how to assemble a power supply that can be modified for voltages between 11V to 24V

DC adjustable via a trim-pot.
No additional hardware or extra wire supplied. DC-DC CONVERTER UNIT:(SMPS1) $44 ea PACKAGE (SMPS1) plus additional hardware): (SMPS2) $79

NEW!! 635nM 5mW LASER DIODE SPECIAL VERY BRIGHT BECAUSE OF THE SHORTER WAVE LENGTH. SPECIAL INTRODUCTORY PRICE $17ea

SORRY NO LENSES AVAILABLE

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major cards with ph. & fax orders, Post & Pack typically $7 Prices subject to change without notice ACN 068 740 081 ABN18068 740 081

SC_OCT_02

Improved Speed Controller for Universal Motors

By JOHN CLARKE

This new speed controller can be used with power tools and appliances rated up to 5A. Use it to control the speed of circular saws, routers, jig saws, electric drills, hobby lathes, lawn edgers and other appliances with universal "brush type" motors.

This circuit is essentially a revised version of the Speed Controller published in September & November 1992. It has been a particularly popular project and readers have come up with countless applications for it.

In fact, you might think that since there are now so many battery-powered and 240VAC power tools with inbuilt speed controls that the uses for a circuit such as this would have declined. In fact, this circuit is more popular than ever and people are constantly coming up with new applications for it.

Apart from drills and circular saws, the speed control is particularly useful for controlling routers and jig saws (when cutting plastics, for example), hobby lathes (which use sewing machine motors), food mixers (where the in-built speed control has failed) and lawn edgers (where full speed operation tends to frequently break the Nylon line). The speed controller also offers much improved operation of sewing machines, in comparison to the conventional resistive pedal controller.

The new 5A Speed Controller is housed in a diecast box which is much more rugged than the previous project which used a plastic case. The diecast case also improves heat dissipation from the Triac.

The controls on the front panel comprise a full/control switch and a knob to set the speed. Power comes in via a 3-core mains lead and mains plug while the outlet is a flush-mount mains GPO (General Purpose Outlet) socket on the front panel.

Speed control range

This speed controller will enable you to set the appliance operating speed over a wide range down to a very slow rate. In fact, the minimum speed will mainly depend on the smoothness which you can obtain. Some power tools and appliances don't run smoothly at very low speeds when run from this type of control circuit and frequently display a behaviour known as "cogging" whereby it runs in short bursts.

So the practical minimum speed for any appliance motor depends on freedom from "cogging".

There is another factor which limits the minimum speed that an appliance can be run at and that is the fact that most universal motors have an inbuilt fan for cooling. Below certain speeds that fan is largely ineffective and so there is no cooling at all. Bear that in mind if you want to use an electric drill as a power screwdriver with this control. You can do it for short periods but if you want to do it for long periods you run the risk of severely over-heating the drill motor.

In the middle range of the speed control, the circuit gives good speed regulation. This means that if the motor is loaded down, the applied voltage is automatically increased to compensate.

At the maximum end of the speed control range, this circuit will not give full speed operation when in variable mode. This is because at the maximum speed setting it is essentially just a high power diode and this means that it is feeding half-wave rectified 240VAC to the motor or about 170V RMS.

So if do you want full speed from the motor, set the speed switch to "full".

WARNING!

(1) This Speed Controller circuit operates directly from the 240VAC mains supply and is potentially lethal. Do not build it unless you know exactly what you are doing.
DO NOT TOUCH ANY PART OF THE CIRCUIT WHILE IT IS PLUGGED INTO A MAINS OUTLET and do not operate the circuit outside its earthed metal case.

(2) This circuit is not suitable for use with induction motors or shaded pole motors used in fans – see "What motors can be controlled".

(3) This circuit must only be used with universal "brush type" (series wound) motors with nameplate ratings up to 5A.

(4) Power tools with inbuilt fans must not be operated at low speeds for long periods otherwise they may overheat and suffer damage.

(5) This circuit must not be used to control the power to lamps or electric radiators. To do so would contravene the regulations of the NSW Energy Authority and affiliated state energy authorities.

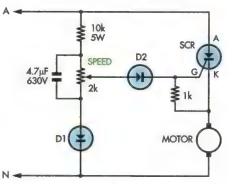


Fig.1: this circuit demonstrates the basic principle of motor speed control. The SCR feeds half-wave rectified AC to the motor and its trigger point is made sooner or later in each positive half-cycle to vary the power.

Basic circuit operation

The circuit is very similar in principle to simple SCR speed controls developed years ago except that we are using a Triac. So to explain the circuit principle, have a look at Fig.1 which is just about the simplest speed control you could get. The SCR device conducts in one direction only and feeds half-wave rectified AC to the motor.

Essentially, the SCR is a rectifier diode which only conducts when it receives a trigger voltage at its gate. Once it starts conducting, from anode (A) to cathode (K), it stays conducting until the load current drops to zero or the circuit voltage is reversed.

Because the SCR is a switching device, it can be used as a very efficient power controller, varying large amounts of current while itself dissipating very little power.

The circuit of Fig.1 controls the AC power to the motor by triggering the SCR into conduction late or early in

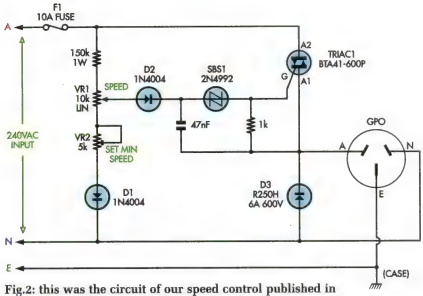


Fig.2: this was the circuit of our speed control published in September 1992. It uses a silicon bilateral switch and 47nF capacitor to give strong gate pulses for reliable triggering.

each positive half-cycle of the 240VAC waveform; being a diode, the SCR does not conduct at all during the negative AC half cycles.

If the SCR is turned on early in each AC half cycle, the power fed to the motor will be relatively high. Conversely, if the SCR is turned on late in each AC half cycle the power fed to the motor will be relatively low and hence the motor will run slowly.

The trigger voltage for the SCR comes from VR1, a 2kΩ potentiometer connected in series with a 10kΩ resistor and diode D1. This 2kΩ potentiometer is fed with half-wave rectified AC which is partly smoothed by the 4.7μF capacitor across it. The resulting ramp voltage from the wiper is fed to the gate of the SCR via diode D2.

Speed regulation

Now you might ask: why just use an SCR and allow conduction on only positive AC half cycles? Why not use a Triac which can be triggered into conduction on both positive and negative half cycles?

The answer is that we could but then a fundamental advantage of this basic circuit would be lost. The advantage is speed regulation. A circuit with good speed regulation will maintain a selected motor speed regardless of variations in the load. If you are using a speed controller with an electric drill, you don't want the motor to bog down when you start to drill into the heavy stuff, do you?

So how does the circuit give speed regulation?

The answer is that the circuit monitors the back-EMF from the motor. Back-EMF can be defined as the voltage developed by a motor which opposes the supply voltage. The higher the speed of the motor, the higher the back-EMF. This circuit monitors the back-EMF in the following way.

Notice that one side of the motor is connected directly to the SCR's cathode while the other side is connected to the cathode of diode D1 and to the mains Neutral wire. This means that the gate-to-cathode voltage applied to the SCR is the difference between the wiper voltage from VR1 and the back-EMF generated by the motor (disregard the voltage drop across diode D2).

Actually, in so-called universal motors (AC/DC series motors with commutators as used in most power tools and appliances), there are two back-EMFs generated. The first is a function of motor speed and the remanent magnetism (remanence) of the field coils. It is generated during the time when the SCR is not conducting; ie, during the negative half cycles of the AC waveform and during the first portion of the positive half cycles before the SCR conducts. The second back-EMF is generated during the time when the SCR is conducting and since the there will now be current flowing in the field coils (and also in the armature), this back-EMF will be higher than the first.

We are only concerned with the back-EMF generated while the SCR is not conducting since it is this voltage which determines how late or early in each positive half cycle that the SCR begins conduction. Hence, the motor applies negative feedback to the gate of the SCR.

This negative feedback enables the circuit to give good

What motors can be controlled?

Virtually all power tools and small appliances use so-called "universal" motors. These are "series wound" motors with a commutator and brushes. The "series wound" term refers to the fact that the motor armature and field windings are connected in series and this allows the motor to be run from AC or DC, ie, "universal".

Induction motors must not be used with this speed controller. So how do you make sure that your appliance is a universal motor and not an induction motor?

In many power tools you can easily determine that the motor has brushes and a commutator – you can see sparking from the brushes and that settles the matter. But if you can't see the brushes, you can also get a clue from the nameplate or the instruction booklet.

So how do you identify an induction motor? Most induction motors used in domestic appliances (eg, washing machines, fridges, water blasters, swimming pool pumps) will be 2-pole or 4-pole and always operate at a fixed speed. Typically this is 2850 RPM for a 2-pole unit or 1440 RPM for a 4-pole unit. Bench grinders typically use 2-pole induction motors.

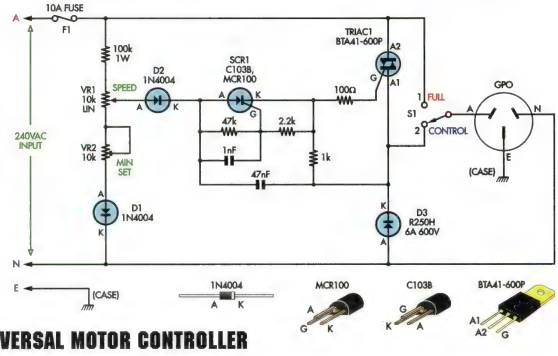


Fig.3: this is the revised speed control circuit which now uses a sensitive gate SCR as the trigger source for the high power Triac.

SC 2002 5A UNIVERSAL MOTOR CONTROLLER

speed regulation. Say a particular motor speed is set by VR1 and then the motor speed tends to drop because of an increase in loading.

This reduces the motor back-EMF and therefore increases the voltage at the gate the SCR. More correctly, it means that the ramp voltage at the SCR gate will exceed the voltage at the SCR cathode earlier in the positive half cycle and hence more power will be applied to the motor. This will tend to correct the drop in motor speed.

It's not perfect but it's a lot better than having no speed regulation at all.

Better circuit

Now the basic circuit presented in Fig.1 will actually work. In fact, it was the basis of most speed control circuits used about 30 years ago.

However, it has a number of drawbacks. First, the power dissipation through the 10kΩ resistor is about 2.4 watts which means that it gets rather hot. Second, even though the current through the 10kΩ resistor and VR1 is relatively high, it won't be enough for reliable triggering of higher power

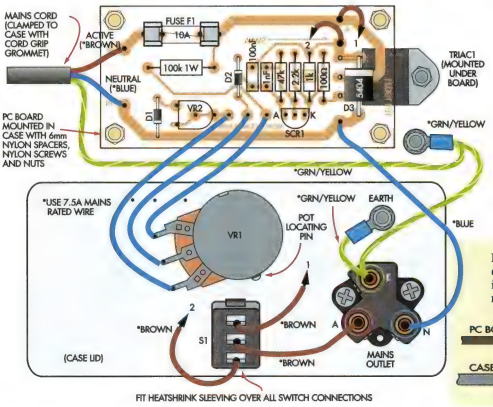
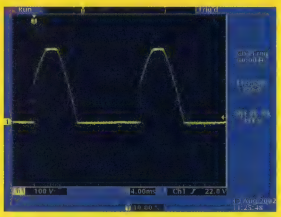
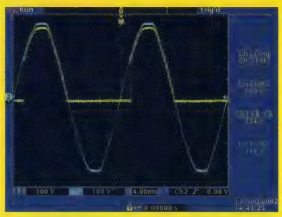


Fig.4: Use this diagram when assembling the PC board and completing the wiring inside the case.

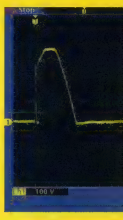
Fig.5 (below): the mounting details for the Triac. It is an isolated tab device and does not need an insulating washer.



Scope 1: This waveform shows the Speed Controller set for maximum output when driving a resistive load. Note that the waveform is essentially a half-wave rectified sinewave with an RMS value of 170V. The early part of each positive half-cycle has been chopped out, due to the fact that the trigger circuit does not fire the Triac until about 2 milliseconds after the start of the cycle.



Scope2: The same waveform now superimposed on the 240VAC 50Hz input waveform (in blue). Notice there is some small voltage loss across the Triac. The "flat-topping" of both waveforms is commonplace in areas where there are lots of fluorescent or gas discharge lights and/or PCs, which clip the peaks of the mains waveform. This is because capacitive-filter supplies take their power from the peaks of the AC waveform.



Scope3: This waveform Controller set for max driving an electric dr motor). Notice that th beginning of each pos waveform, caused by This caused the gross measurement of 1.49

SCRs. And third, the circuit is not particularly good at very low speed settings.

Now fast-forward to September 1992 and have a look at the speed control circuit of Fig.2. You can see the similarities between it and Fig.1. Instead of an SCR, we have used a Triac and instead of feeding the gate directly from VR1 as in Fig.1, a trigger circuit consisting of a silicon bilateral switch (SBS1) and a 47nF (.047µF) capacitor has been used.

While the Triac is capable of conducting on both positive and negative half cycles of the 240VAC 50Hz waveform, this circuit only enables it to trigger on positive half cycles, because of the rectifier action of diode D1.

A silicon bilateral switch is a voltage breakover device; ie, at voltages below its breakover point it is essentially open circuit but once the breakover voltage is reached, it becomes a low value of negative resistance.

Don't worry too much about the "negative resistance" bit. All you have to remember is that it is used in conjunction with the 47nF capacitor. This charges up from VR1 via diode D2 until it reaches the break-over voltage of about 8V. At this point it dumps the capacitor's charge into the Triac's gate to trigger it into conduction and the cycle repeats for the next positive half cycle of the mains AC waveform.

The energy stored in the capacitor is quite enough to trigger even insensitive Triacs, hence we are able to use a high power 40A device in this circuit.

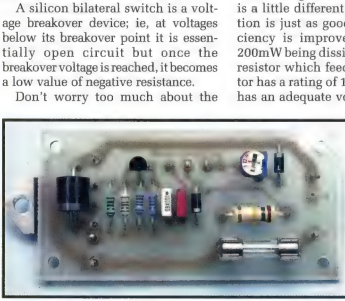
In this circuit, the motor back-EMF acts to reduce the charging voltage to the 47nF capacitor rather than reducing the SCR gate voltage as in Fig.1. But although the circuit arrangement is a little different, the speed regulation is just as good. The circuit efficiency is improved too, with only 200mW being dissipated in the 150kΩ resistor which feeds VR1. This resistor has a rating of 1W to ensure that it has an adequate voltage rating.

The functions of the three diodes in the circuit need to be explained. Diode D1 is there to reduce the power dissipation of the series resistor string and to ensure half-wave operation of the circuit. D2 is there to protect the gate of the Triac when it is in the conducting state – terminal A1 can be above the potential of the gate.

Diode D3 has been included as a flyback diode to quench the large inductive spike generated by the motor at the end of each positive half cycle. While the voltage spike does not cause any damage to the circuit, it does have the effect of disrupting the back-EMF monitoring system described above.

VR2, the 5kΩ trimpot in series with VR1, is there to provide a minimum setting for the circuit.

One question we have not answered so far is why we specified a Triac instead of an equivalently rated SCR. The reason is quite simple. We did it to avoid the need for parts stockists to have to order in another device. We



The completed PC board, reproduced same size. At right is the underside of the board showing the mounting of the triac. Its tab is isolated so no insulating washer is required – but give it a good smear of heatsink compound to help it keep its cool!

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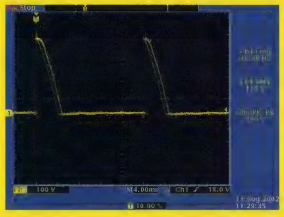
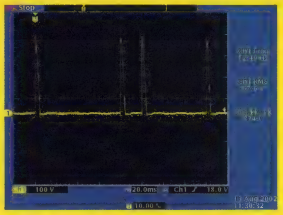


Scope4: Now set for a lower speed from the electric drill, the Triac is on for a shorter time and the RMS value is reduced to 115V. Again, the "judder" in the waveform is caused by commutator hash. Again, this hash also caused the slight frequency measurement error.



Scope5: Now set for a very low speed from the electric drill, this scope waveform demonstrates motor "cogging". As you can see, the Triac is no longer firing reliably on each positive half-cycle. The frequency measurement is also meaningless. This speed setting is too low to be useful as the drill will not run smoothly.

have specified a 600V 40A device so that it can withstand the "locked rotor" current of any power tool with a nameplate rating of up to 5A.

Note that a "locked rotor" condition may well blow the 10A fuse but the 40A Triac should not be damaged. Yes, we have done this test!

Another reason for using the 600V 40A Triac is that it is an isolated tab device. This means that it can be attached directly to the metal case without any need for a mica washer or other means of insulation.

Latest circuit version

The circuit of our new 5A Speed Controller is shown in Fig.3. As already mentioned, this is a revised version of the design we featured in the September & November 1992 issues. Our new circuit replaces the now hard-to-get SBS with SCR1, a C103 sensitive gate SCR and this provides the same capacitor dump function as the SBS.

The 47kΩ and 2.2kΩ resistors form a voltage divider between the anode and cathode of the SCR with the divided voltage applied to the gate. The SCR conducts when the gate voltage reaches 0.6V and is triggered by a mere 200uA of gate current.

Because of the resistive divider, the voltage across SCR1 must rise to some 13.4V before the gate reaches the 0.6V sufficient to trigger the SCR. When the SCR fires, the charge on the 47nF capacitor is dumped into the gate of Triac1 via the 100Ω resistor to fire the Triac. The 1nF capacitor between anode and gate of SCR1 is there is provide more reliable triggering when there is lot of commutator hash from the motor being controlled.

Note that the revised circuit uses slightly different component values compared to Fig.2. Apart from the resistors and capacitors associated with the SCR, the original 150kΩ 1W resistor is changed to 100kΩ while the trimpot VR2 is now 10kΩ instead of 5kΩ.

By the way, the 100kΩ resistor is a 1W type, not for disippation but to

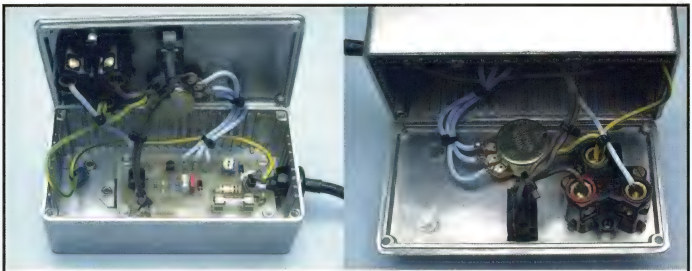
Parts List – 5A Universal Motor Speed Controller

1 PC board coded 10110021, 79 x 38mm
1 diecast box 120 x 66 x 38mm (Altronics H-0453 or equivalent)
1 panel label 119 x 65mm
1 mains flush-mount socket (Jaycar PS-4090 or equivalent)
1 SPDT 250V 6A rocker switch (S1; Altronics S-3215)
1 10kΩ linear 24mm potentiometer (VR1)
1 knob for potentiometer
1 7.5A three-core mains cord and moulded 3-pin plug
1 10A M205 fast blow fuse
2 M205 PC board mount fuse clips
1 cord-grip grommet to suit mains cord
2 crimp eyelets or solder lugs for earth connection
4 6mm Nylon spacers
2 M3 x 10mm csk screws
1 M3 x 10mm screw
2 3mm star washers
4 M3 x 15mm Nylon screws and nuts
4 stick-on rubber feet
1 200mm length of blue 7.5A 250VAC wire
1 200mm length of brown 7.5A 250VAC wire
5 100mm long cable ties
8 PC stakes

Semiconductors
1 BTA41-600P Triac (TRIAC1)
1 C103B sensitive gate SCR (SCR1)
1 R250H 6A 400V diode (D3)
2 1N4004 1A 400V diodes (D1,D2)

Capacitors
1 47nF (.047μF) 63V MKT polyester
1 1nF (.001μF) 63V MKT polyester

Resistors (0.25W 1%)
1 100kΩ 1W 5% 1 47k
1 2.2kΩ 1 1kΩ 1 100Ω
1 10kΩ horizontal trimpot code 103 (VR2)



These two views inside the case show exactly how the wiring should be done. When we say exactly, we mean it: don't take chances or shortcuts with 240VAC. Ensure that any hookup wire you use is 250VAC-rated.

ensure that it has an adequate voltage rating.

As mentioned above, switch S1 provides full power operation, bypassing the Triac so that the motor gets the full 240VAC applied to it. Note that the switch must be a changeover type to select either Active or the Triac A1 output rather than just using a single switch across the Triac. In the latter case, there would be a short circuit (which would blow the fuse) when diode D3 and the Triac conducts on negative half-cycles of the 240VAC mains.

Construction

All the components of the 5A Speed Controller are mounted on a PC board coded 10101021 and measuring 79 x 38mm. It is housed in a diecast box measuring 120 x 66 x 38mm.

Begin construction by checking the PC board against the pattern in Fig.7. There should not be any shorts or breaks between tracks. If there are, repair these as necessary. Use the diagram of Fig.4 as a guide when assembling the PC board and completing the wiring inside the case.

Start assembly by inserting the PC stakes at the external wiring connection points on the PC board. Then insert the resistors, using the table below as a guide to the values. When inserting the diodes, take care with their orientation.

Note that in a kit you may be supplied with a C103B or MCR100 for SCR1. If so, not that the pinouts for the C103B are reversed to those of the MCR100, as shown on the circuit of Fig.3. Make sure you insert SCR1 into the PC board correctly, otherwise the circuit won't work.

The capacitors can be installed next. Use the table below to check the values. VR1 can also be installed at this stage. Fuse F1 is mounted in fuse clips which attach to the PC board as shown on Fig.4. Clip the fuse into the clips first, insert them into the PC board and solder in position.

The Triac is mounted on the underside of the PC board with its leads protruding up through the holes in the PC board. Bend the leads so that the copper side of the PC board is 6mm away from the back of the Triac body, as shown in Fig.5.

Insert the PC board into the case and mark out the mounting hole position for the standoffs and for Triac1. Remove the PC board and drill out the holes. You will also need holes in the end of the case for the cord-grip grommet and the earth lug screw. The cord-grip grommet hole is elongated but must be a tight fit to properly grip the mains cord.

The hole for Triac1 must be deburred with a larger drill before it is secured in place.

Attach the PC board to the case with Nylon standoffs and Nylon M3 x 15mm screws. Nylon screws are essential here, to avoid the possibility of arcing from the PC board tracks to the mounting screws.

Use metal screws for the Triac and earth connections. Secure Triac 1 to the case with a metal M3 x 10 screw and nut after applying a smear of heatsink compound on the mating surfaces. Note that the specified Triac is an insulated tab device and does not require an insulating washer.

Attach the mains cord wires to the PC board and lock the cord in place with the grommet. Mark out and drill the front panel for the mains outlet, speed control pot (VR1), the earth screw and the switch.

You can use the front panel label as a guide to the positions. The cutting template for the mains socket is shown

Resistor Colour Codes

No.	Value	4-Band Code (1%)	5-Band Code (1%)
❒ 1	100kΩ	brown black yellow brown	N/A
❒ 1	47kΩ	yellow violet orange brown	yellow violet black red brown
❒ 1	2.2kΩ	red red red brown	red red black brown brown
❒ 1	1kΩ	brown black red brown	brown black black brown brown
❒ 1	100Ω	brown black brown brown	brown black black black brown

Capacitor Codes

Value	Old Value	IEC Code	EIA Code
47nF	.047μF	47n	473
1nF	.001uF	1n	102

in Fig.6.Note that it is important to drill a small hole for the locking tab on the potentiometer to prevent it rotating inside the case.

Attach the front panel label and secure the mains socket. Attach the pot and switch.

Wiring must be done using 7.5A 250VAC-rated wire. Earth connections are soldered or crimped to the solder lug using green/yellow mains wire. The lugs are secured to the case using a metal screw, nut and star washer. Tie the wires with cable ties to prevent them breaking from their terminations.

Finally, attach rubber feet to the base of the case.

Note that all of the circuit is connected to the 240VAC mains supply and is potentially lethal. Do not touch any part of the circuit when it is plugged into a mains outlet. Always remove the plug from the mains before touching the circuit. In particular this applies to adjustment of trimpot VR2.

After testing the controller, then you need to adjust trimpot VR2. Plug in your favourite power tool and note how it runs at the minimum setting of VR1. If it could run slower, disconnect the circuit from the power, adjust VR2 and then try again. You may then want to try other power tools to get a compromise setting for the trimpot.

IMPORTANT: Do not operate the circuit with the lid off the case. SC

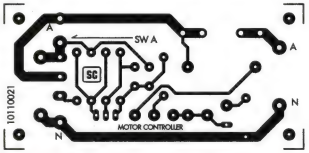


Fig.7: actual size artwork for the PC board.

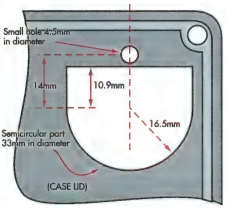


Fig.6: these are the panel cutout details for flush-mount AC socket.

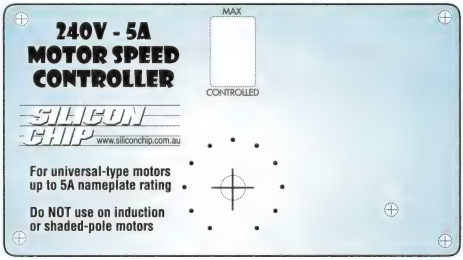
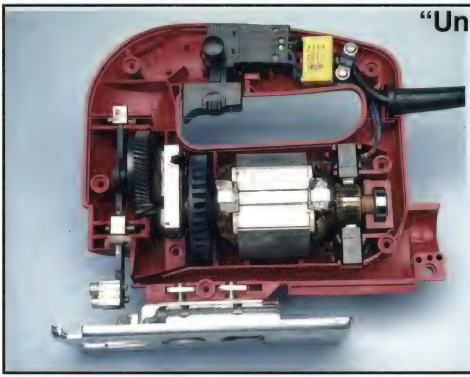


Fig.8: actual size artwork for the front panel label.



"Universal" motors: the inside story

This photo shows the construction of a typical double-insulated jig-saw which uses a universal motor with brushes and a commutator. The plastic case provides the "double insulation" construction and it also provides the alignment for the motor bearings, brushes and gears. Note the integral fan on the motor shaft to provide cooling.

This jig-saw also has speed control built into the trigger switch. This motor is actually wound for operation from 180V so it gives a wide (no load) speed control range from 500 to 2900 RPM.

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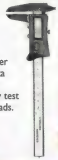

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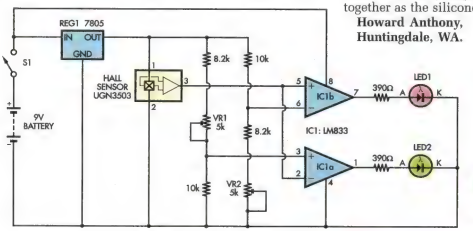
CIRCUIT NOTEBOOK

Interesting circuit ideas which we have checked but not built and tested. Contributions from readers are welcome and will be paid for at standard rates.

DC automotive tester with current probe

The inspiration for this circuit came from the Auto Ammeter published in the June 2002 issue of SILICON CHIP. It avoids the hazards of trying to break into automotive circuits to make measurements.

A 3-terminal regulator, REG1, supplies the 5V needed for the Hall Effect sensor whose output at pin 3 is nominally at +2.5V and is fed into opposite inputs of comparators IC1a and IC1b. The other comparator inputs are connected to resistive voltage dividers and their thresholds set by trimpots VR1 & VR2. The trimpots are set so that LED1 and LED2 are just turned off. This setting is sensitive enough to detect the current drawn by a 5W globe in a 12V circuit.

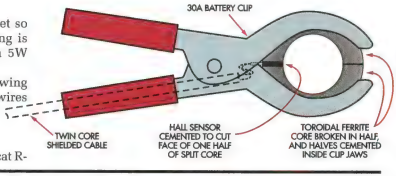


The two LEDs will show which way current is flowing in a circuit which is particularly useful when testing wires (which do not have the correct wiring code) within a wiring harness.

A simple current probe can be made using a 30A battery clip (DSE cat P-6420) and a small toroid (DSE cat R-5410). The toroid should be cut in half and the halves kept oriented in the same way. To do this, you score all round the surface of the toroid with a hacksaw and then carefully snap it in half. Be prepared to make a mess the first time you try this, so purchase several toroids.

The Hall Effect sensor is sandwiched between the toroid halves and silicone is applied to one side. Silicone is also used to hold the two toroid halves inside the clip. The battery clip also holds the lot together as the silicone cures.

Howard Anthony,
Huntingdale, WA.

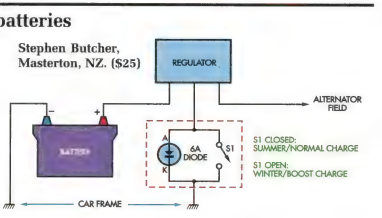


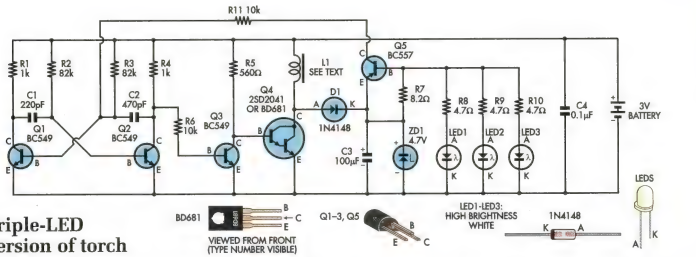
Winter charge booster for 12V car batteries

Stephen Butcher,
Masterton, NZ. ($25)

This is really a project for winter when the colder temperatures reduce battery capacity and make engine starting harder. This circuit is designed to shift the regulator's earth reference voltage up by about 0.6V to increase the maximum charging voltage.

The circuit can be fitted in a small box and mounted as close as possible to the regulator. The switch can be set to summer or winter, as the case may be. The extra voltage to the battery will do little harm given that it is less willing to accept a charge in cold weather and greater demands are made of it with more difficult starting, lights, wipers, etc.





Triple-LED version of torch

This circuit includes the additions by Duncan Graham in January 2002 and Rick Matthews in the May 2002 issue of SILICON CHIP to make quite an improvement on the circuit originally published in the December 2000 issue.

It drives three white LEDs, increases the operating voltage range and regulation and allows the use of two cells rather than one.

Q4 is now a high-gain Darlington transistor and its associated base resistor R5 is increased from 220Ω to 560Ω.

L1 was replaced with a pre-wound coil from an old computer power supply. The coil is a toroid of 13mm diameter with approximately 70 turns of 0.5mm enamelled copper wire.

C3 was increased from 47µF to 100µF for extra filtering at higher current. R11 (10kΩ) was added in series with the current regulator as without it Q5 would stop the oscillator altogether instead of just altering the pulse width.

R7 was changed from 24Ω to 8.2Ω to allow the circuit to deliver 60mA to drive three LEDs instead of one. Resistors R8, R9 & R10 (4.7Ω) were added to ensure that the LEDs shared the current equally. The three white LEDs are 15CD (yes, 15 candelas!) available from Oatley Electronics for $6.00 each.

Philip Chugg,
Rocherlea, Tas. ($40)

One of nine sequencer

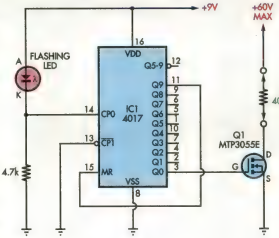
This novel circuit uses a flashing LED as the clock input for a 4017 decade counter.

Typical flashing LEDs (eg, DSE cat Z-4044) flash at about 2Hz so the outputs Q0-Q9 will cycle through at that rate.

For example, Q0 will turn on for half a second, then Q1, then Q2 etc up to Q8 then it will start at Q0 again. Up to nine outputs can be used. If you want fewer outputs, connect an earlier output to MR, pin 15. If MR is not used, connect it to 0V.

Uses for the circuit include sequencing different strings of Christmas lights etc.

The resistor from CP0 to ground can be anywhere from about 330Ω to about 10kΩ. Lower values will cause the LED to flash more brightly if that is required.



With a 4.7kΩ resistor as shown, the clock input CP0 (pin 14) will alternate between about 2V and 7V.

To drive loads of up to 40W at up to 60V, connect each output to the gate of a 2N3055E or equivalent Mosfet (MTP3055E etc), as shown for Q0.

Peter Olsen,
Lugarno, NSW ($35)

CONTRIBUTE AND WIN!

As you can see, we pay good money for each of the "Circuit Notebook" contributions published. But now there's an even better reason to send in your circuit idea: each month, the best contribution published will win one of these superb Wavetek Meterman 85XT true RMS multimeters - valued at around $380! So don't keep that brilliant circuit secret any more: send it to SILICON CHIP and you could be a winner!

Contributions must be your own original work or a major adaptation and not published elsewhere nor submitted for publication elsewhere. SILICON CHIP's decision is final.

Headlight controller for motor bikes

This circuit automatically turns a motor cycle's headlight on and off, independently of both the light and ignition switches, provided the battery is fully charged.

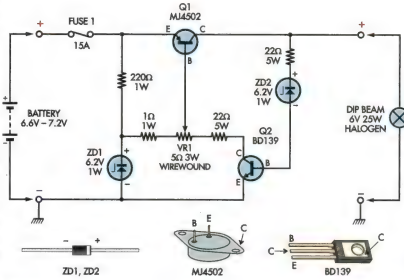
The first stage uses the 220Ω resistor and ZD1 to hold transistor Q1 off while the motor is not running; it draws about 2mA.

Once the battery voltage exceeds 7.0V during charging, Q1 begins to turn on. The last stage uses the 22Ω resistor and ZD2 to turn on transistor Q2, which pulls the base of Q1 down, switching it hard on. In conjunction with the Vbe drop of Q2, ZD2 will turn off Q2 at a battery voltage of about 6.7V.

In practice, this means that the headlight will be on most of the time while the motor is running and charging the battery.

Heatsinks are required for both transistors. The circuit can be mounted adjacent to the battery with a single lead going to the headlight power feed.

Stephen Butcher,
Masterton, NZ. ($35)



Touch-enabled fuel cut-off for diesels

Ignition immobilisers work well for petrol cars but are no use for diesel-powered vehicles which require a fuel cut-off solenoid.

This circuit fills that need. It is auto arming and gives an armed/disarmed indication via the fuel gauge. Under the bonnet, it can to be disguised as a horn relay, making it easy to hide as well as costing less than $20 to build.

To switch on the circuit, turn the ignition on and then use your hands to connect the touch point to the chassis (say via the ignition key). The tiny current which flows through your body turns on the Darlington-connected transistors Q1 & Q2 which activate relay RLY1.

One set of contacts of RLY1 is used to latch it on via diode D2 and also switches on relay RLY2 for the fuel pump or fuel cut-off solenoid.

The second set of contacts of RLY1 connects the fuel gauge to the fuel sender, making the fuel gauge operate normally.

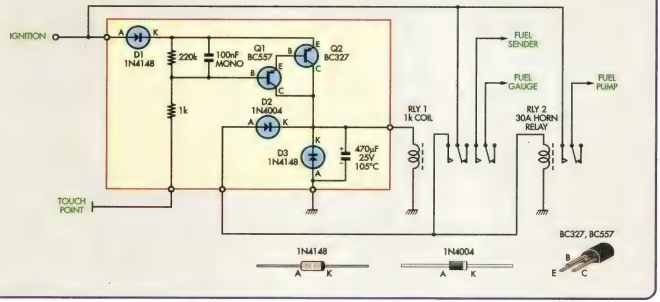
If the circuit isn't switched on, the fuel gauge should indicate that the tank is empty and the fuel pump or solenoid won't operate.

Note: this concept won't work in those vehicles in which the fuel gauge indicates even when the ignition is turned off.

The 470µF capacitor and diodes D1 and D2 provide a 0.5-second time-constant, so the circuit is less sensitive to momentary power loss and therefore safer.

The 100nF capacitor and 220kΩ pull-up resistor at the base of Q1 are there to prevent false switch-on at ignition turn-on and they reduce the sensitivity of the touch point.

A. Doyle,
Rydalmere, NSW. $40



Simple AM transmitter uses crystal ear piece as microphone

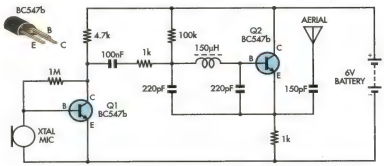
There are not many AM transmitters that are easier to build than this one because the inductor is not tapped and has a single winding. There is no need to wind the inductor as it is a readily available RF choke (eg, Jaycar Cat LF-1536).

To make the circuit as small as possible, the conventional tuning capacitor has been dispensed with and fixed 220pF capacitors used instead.

To tune it to a particular frequency, reduce one or both of the 220pF capacitors to raise the frequency or add capacitance in parallel to lower the frequency.

Q1 is biased with a 1MΩ resistor to give a high input impedance and this allows the use of a crystal ear piece as a low cost microphone.

Peter Goodwin,
Southland, NZ. ($30)



Battery Status Indicator

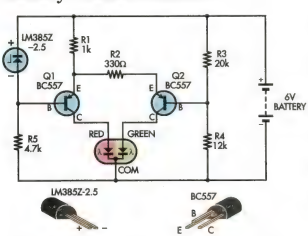
This circuit gives a progressive indication of the condition of a 6V (4-cell) battery. It is based on a 3-lead tri-colour LED (Jaycar Cat ZD-1735 or equivalent).

With a fresh 6V battery, transistor Q1 is cut off and Q2 functions as a current source, feeding about 2mA to the green LED. As the voltage from the battery drops, the bias on Q2 is reduced and so it is turned on less and Q1's emitter is no longer held below its base. Thus Q1 turns on gradually (as battery voltage falls) and so the red LED is progressively lit, producing a colour change from green to orange.

Finally, as the battery falls below 4V, Q2 is cut off and Q1 turns on fully, to give a red indication.

While this circuit has been set for a 6V battery, the transitions can be changed to suit other voltages.

Tony Ellis,
Porira, NZ. ($35)



Smoke alarm battery life extender

While smoke alarms are quite cheap devices, the cost of 9V batteries quickly exceeds their purchase price.

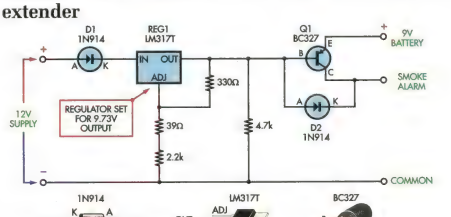
Added to that is the irritation of random beeps from the alarm as the battery reaches the end of its useful life.

This circuit allows typical smoke alarms to be powered from the 12V supply in a burglar alarm while still keeping the standard 9V batteries in place. It extends the 9V battery life to that of its "shelf life" as the battery is only required to drive the smoke alarm in the event the 12V supply is removed or shorted out.

In normal operation, the LM317 supplies 9.7V and this is fed via diode D2, resulting in just over 9V at the smoke alarm supply terminals. Q1 is not biased on, so the 9V battery is disconnected from the circuit. If the 12V supply is removed, the output of the LM317 will be 0V and Q1 will be biased on via the 4.7kΩ resistor and thus the smoke alarm will continue to be powered.

The circuit could be assembled on a piece of Veroboard and fitted inside the smoke alarm. Alternatively, you could house the circuit and 9V battery within a standard electrical flush-mount box which the smoke alarm covers when mounted.

Paul Blackler,
Spreydon, NZ. ($35)



Electronics in Schools:

Recently, SILICON CHIP received a phone call from David Kennedy who teaches electronics to Higher School Certificate students at Mater Maria College in Warriewood.

He told us that all of the students' final year projects were laid out ready for marking by HSC assessors (in fact, they were being marked as he spoke) – and as Mater Maria College is only a stones-throw from the SILICON CHIP offices, he thought that we might be interested in seeing what the students had achieved.

He was sure the students would also be keen to hear any comments we had – positive or negative – about the projects. While anything we said would not affect the HSC marks, he thought the students themselves would benefit.

So it was during an afternoon in late August, Leo Simpson and myself went over to Mater Maria (to our knowledge, the only school in the area with electronics in the senior curriculum) to see what the students had achieved.

Ambitious!

To say we were impressed is a massive understatement. "Blown away" is an expression which springs to mind. Without exception, the projects were extremely ambitious and, despite some unfortunate choices which we'll go into shortly, were well executed. Not a crystal set nor battery-powered gizmo in sight!

We must admit we were surprised at this, given the fact that many (perhaps the majority of) students in the class had little or no experience in electronics before embarking on the course (some hadn't even touched a soldering iron!).

Most of the projects involved sound systems or lightshows of some description. Hardly surprising, that, given the ages of the students.

Some of the projects came from the pages of SILICON CHIP. We recognised the "Discolight", several amplifiers and other audio modules.

Many decided to go for high power amplifiers and speaker systems. Not just your average stereo amplifiers and speakers but as our photos show, some

the Class of 2002

by Ross Tester

pretty impressive ones. Some even did both amplifier and speakers and a couple had gone the full mogilla with amplifier, speakers **and** lightshow!

Another student had chosen to make a sub-woofer amplifier and box for his car. This amplifier wasn't a 12V system, no sir. He'd built the full mains-powered system then added a 12-240V inverter, thank you very much!

One very impressive project involved the routing-out of a solid guitar amplifier to house a variety of sound effect boards: waa waa, fuzz, and so on, all selectable by the guitarist as he/she played without resorting to foot pedals and trailing cables.

The project itself is only part of the HSC mark. It's worth 40% so is a very important part (the other 60% is in the dreaded examination – and the students can be asked anything from Ohm's law to detailed semiconductor physics).

As well as the project building, standard and presentation, marks were awarded on the supporting documentation: design ideas, costings, implementations, drawings, circuits etc.

These ranged from notes in an exercise book to a very impressive document that would have done an engineering workshop (or the military) proud, with exceptional standard of both presentation and content.

Careers

Most of the students had already chosen technical careers: some wanted to do electrical/electronic engineering or related subjects at university; another wanted to gain an electrician's apprenticeship. Yet another had already signed up for the Air Force (which would also gain him a university place).

Despite the complexity of the subject, and the fact that many students chose it as a precursor to a university course, David Kennedy was quite critical of the fact that it didn't count towards a university admission score. It counts towards the HSC, of course – but students studying much "softer" subjects gained that all-important ranking.

Doesn't quite seem fair, does it?

The 12 students who make the up HSC Design & Technology (Electronics) Class at Mater Maria College, Warriewood, with teacher David Kennedy at left. Some of the projects and documentation can be seen in this photo, with a small selection of the projects shown opposite.

The ETI480 Oscillator Amplifier

While some students built some very modern amplifiers, many chose the (in?)famous ETI480 amplifier module. The reason given is logical enough: it's cheap. There is another, associated word that springs to mind!

As many found out, the ETI480 is not a good choice (especially when Higher School Certificate marks depend on it!). It's true that it looks very simple to build. In fact, many thousands have been constructed for that very reason in the 25+ years since it was first described in Electronics Today. How many of those actually work is another thing altogether.

Now that SILICON CHIP owns the copyright to articles published in ETI as well as EA, we can say that the ETI480 has always been a dog of an amplifier. It takes off at the drop of a hat (most students had that trouble, some going through several output transistors) and it's not a good performer, even by 1976 standards.

The published specs state 100W output into 4Ω – but if you look at the graph in the December 1976 issue, that's at somewhere between 3% and 5% or more distortion. Realistically, it's more a 60W amplifier at anything like reasonable distortion figures.

According to Mr Kennedy, there was considerable panic the day before marking (and even well into the night before!) as amplifiers continued to destroy themselves. Incidentally, the ETI480 is a regular topic of newsgroups on the 'net – almost invariably along the lines of "how do I get it to work" and "how do I stop it oscillating!" (There is insufficient supply bypassing, among other things).

Having seen the demand for a reliable, low-cost but reasonably high performing amplifier module for school projects, etc, SILICON CHIP has placed this on the upcoming projects list.

We're determined, for the sake of students and constructors everywhere, to finally lay the ETI480 to rest!

As they say in the classics, "watch this space!"

SC

6+ Megapixel SLRs

In recent months, single-lens reflex cameras have been announced/ released offering a staggering 6+ megapixel resolution. They're claimed, for all intents and purposes, to offer "film" quality. Do they?

Here's what you get in the EOS D60 kit for your not inconsiderable amount of money: the Canon EOS D60 body, shoulder strap, charger, Li-Ion rechargeable battery, various input/output cables and two CDs of PC/Mac photo manipulation software, including Photoshop LE. Notice what's NOT there? That's right – a lens!

Just how far can digital camera technology go? And just how good can they get? Recently we had a (very!) short opportunity to have a look at one of the new breed of high resolution digital cameras.

We're talking serious product here, not your run-of-the-mill digitals which are fast reaching the "free in every packet of cornflakes" stage. OK, slight exaggeration – but you get the drift.

While we've lusted after several digital cameras in the past year or so, they have been in the 3-4 megapixel range and most have been so-called "compact digitals" – more intended for consumer happy snaps, blown up to no more than postcard size, than for serious users (eg, very keen amateurs, or professionals such as media photographers, wedding/function/PR photographers, and so on).

And while 3 or 4 megapixels can give good results, by-and-large they have not been capable of competing with the results from most SLR (single-lens reflex) 35mm film cameras – even relatively inexpensive ones. When you wanted to make a big enlargement, or crop a small section of the image, film has won every time.

Then back in March, I heard about three new digital cameras about to come onto the market – the Nikon D100, Fuji S2 and the Canon EOS D60 – which could change all that. All offered more than 6 megapixel resolution, in a physical format akin to the SLRs we've used for decades. In fact, like most SLRs, they featured a wide range of interchangeable lenses, either from their own stable or from a myriad of aftermarket lens suppliers.

As it happens, the Nikon and Fuji are based on essentially the same platform and use the same lenses. The Nikon was scheduled for release in July but no firm release date could be obtained for the Fuji. The Canon was first released around March but was in extremely short supply. There was little point in talking to Fuji but we asked both Nikon and Canon to make a review model available. Nikon promised, Canon delivered.

So in this brief look at the state-of-the-art in digital cameras, we only look at the Canon EOS D60. The other two, at least from our research, will be quite similar.

The Canon has a slight edge on the other two in resolution – 6.3 megapixels effective, versus the Fuji and Nikon's 6.1 megapixels effective. The sensors in digital cameras have more pixels than actually used – 6.52 in the case of the Canon. There are limitations, mainly optical, on how much of the sensor can be used to produce an image.

Affordable?

Right from the outset, we have to say that the new high resolution digital SLRs are not for everybody. They are expensive (some might say very!) – and their attachments are expensive.

The body kit (as pictured above) for the Canon EOS D60 will set you back more than five thousand dollars. That does NOT include a lens. A zoom lens from Canon's "EF" family (16-35mm; f2.8) another three grand. Add an electronic flash and you're nudging the ten thousand dollar mark.

That's serious money – and for that, you have to be a serious photographer.

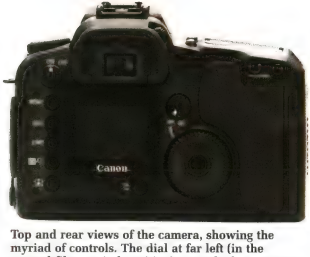
Having said that, there are many serious photographers! Stocks of the EOS D60 are in such short supply world-wide that you'll almost certainly go on a waiting list. (Lucky, that – it gives you time to save up!).

We said before that these cameras were aimed at serious amateurs or professionals. A typical example is sports photography, especially press sports photography.

With a camera such as this, a photographer can take his pictures, download to a notebook computer and email a selection via mobile phone to anywhere in the world within a few minutes of the action.

During the Sydney Olympic Games, there were some reports of photos taken during an event, printed in newspapers and delivered back to Homebush Bay before the spectators

First look/review by *SILICON CHIP* photographer, Ross Tester



Top and rear views of the camera, showing the myriad of controls. The dial at far left (in the normal film rewind position) controls the exposure modes, the thumb dial on the right is for exposure speed. The rather confusing two on/off switches above control either camera power (top left) or the quick control dial (centre) immediately underneath.

had left the stadium for that event!

That's only possible via the digital route. Just think of the time taken to get the roll(s) of film to a processor (even on site), processing time itself, selection, scanning and despatch to the paper – and you can see why digital is the way to go!

That sort of flexibility and speed is worth its weight in gold to a newspaper. Small wonder then that Canon has been showing off the D60 to most, if not all, of the nation's media groups.

Speaking of the Olympic Games, I was one of those 42,000 "vollies". At the first event, the Triathlon, I was assigned to media access control, checking the passes of press people wanting to enter restricted areas. We had the photographers "corralled" in a holding area for a short while (much to their angst!) and I was able to have a good look (drool!) at their gear.

Even then, a full two years ago, I marvelled at the range of digital cameras (and digital backs for conventional cameras) which many of the world's leading photographers sported. Sure made my 35mm equipment look sick!

Back then, three or four megapixels was pretty much the limit. And back then, I can't recall any of this class of camera available for less than $10,000 (the top-of-the-line models where somewhere up in the stratosphere!) Imagine how much those photographers would give to get their hands on six megapixels at $5000-ish!

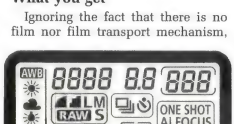
Incidentally, the EOS D60 easily beats Canon's own "flagship" professional camera, the EOS 1 D, at four megapixels. Admittedly, that is one v-e-r-y tricked up camera with many more professional-type features than the D60. But at more than ten grand for the body alone, it would want to be!

Incidentally, some of those long lenses you see used by sports photographers cost many, many times more than the camera itself. The top-of-the-range Canon EF lens, which can do an admirable "head & shoulders" from more than a kilometre away, will cost you more than a house. (There is only one such lens in Australia, by the way!).

We have, until now, been concentrating on that six megapixel resolution. But of course resolution is only a part of the story. Let's now have a look at the D60 in detail.

What you get

Ignoring the fact that there is no film nor film transport mechanism, the EOS D60 is in most senses a "traditional" SLR camera. It has a focal-plane shutter, a flip-up mirror, variable shutter speeds, variable exposure settings . . . everything you'd expect to find. Well, with the possible exception of the lens: that's an option, so you can purchase the one(s) that suit(s) your needs best. (Of course, many purchasers will already have their own selection of lenses).



Some of the detail available in the LCD screen on top of the camera. It doesn't all come on at once . . .

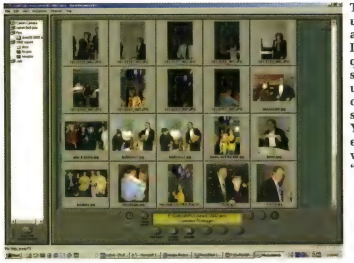
But wait, there's more!

Being totally electronic, there is a whole lot more. First of all, as well as a TTL (through the lens) viewfinder with integral camera data display, there's a 1.8-inch TFT colour monitor built in. There's a large LCD panel on the top of the camera which gives a huge range of information in four languages (more on this later). There's an array of pushbuttons on the rear of the camera along with a quick control dial (there's also another main dial on the top of the camera).

The one thing you can't do is open up the back of the camera – there's no need, of course, because there's no film. One thing this does do is make the body that much more rigid than a standard 35mm.

I was intrigued to note the ⊖ symbol engraved on the body, which in a film camera shows the exact position of the film for extreme macro photography. Except there's no film! (Obviously, this symbol in a digital shows the position of the CMOS sensor).

A small built-in flash is provided



The ZoomBrowser utility is very nice and easy to use. It's a whole lot quicker to select shots using this utility than opening them in, say, Photoshop. You can instantly enlarge each pic to view it on this "monitor screen."

but even more impressive is the camera's "evaluative through-the-lens" (E-TTL) exposure control when using this flash or one of the Canon Speedlite flash guns.

In the time between you pressing the shutter release and when the mirror goes up, the camera fires a brief pre-flash, evaluates the ambient light and reflected illumination, and calculates the exact flash output needed. Now that's clever!

This pre-flash is also part of the red-eye reduction mechanism. (Red-eye occurs when flash light reflects off the blood-filled vessels behind the retina at the back of the eye when the eye's iris is wide open [ie, in low light situations]. The pre-flash causes the iris to briefly close down, minimising reflected red light).

As far as storage is concerned, the EOS D60 accepts Type 1 or Type II CompactFlash cards or even a high capacity Microdrive.

With a 128MB CompactFlash card, you can get around 15 shots in RAW format (3072 x 2048; 7.4MB picture size), 48 shots in large, fine format (also 3072 x 2048 but compressed to 2.5MB picture size) and as many as 255 shots in small (1536 x 1024; 0.5MB picture size). RAW format, by the way, is "as she is shot" – a 16-bit RGB-TIFF, for maximum image quality and content.

Put in a Microdrive and well, the sky is (almost) the limit, especially with the capacity of Microdrives increasing almost exponentially these days.

How big a pic?

Our argument against digital cameras has been on the basis of resolution/enlargement.

Let's look a little more closely at those digital formats and what you can do with them.

We said at the outset that these digital cameras were "near film quality". But what does that mean?

At the highest camera resolution, it's claimed that you could print an A3 size image (420 x 297mm) on photographic paper and it would be very difficult (if not impossible for most observers) to tell the difference between it and the same scene on an A3 print from 35mm film.

In fact, with the processing power available to you in digital format, it could be much better: sharpening, colour correction, special effects, etc are all dramatically easier in digital format.

Incidentally, a copy of Adobe Photoshop LE, the "lite" version of the industry-standard image editing program, is included with the box of goodies you get with the camera. We'll look at the other goodies shortly.

Above A3 and the film starts to take over. But then again, how often do you need to enlarge a 35mm negative (or positive) to greater than A3 (that's about a 16x12 in oldspeak)? Anyone, especially a pro, wanting this type of end result would almost certainly turn to a medium-format film camera.

But for your typical postcard-size prints or even 10x8s (250x200mm) or 12x10s (300x250mm), the convenience and flexibility of the hi-res digital wins hands down.

Control of your pictures

We cannot hope to tell you every-

We know these aren't particularly exciting shots but they do prove a point! Video monitors and TV screens (left) usually take a fair bit of mucking around to get just right. This shot was taken hand held – I just aimed the camera, zoomed in and pressed the shutter. The D60 did everything else – and did it right! Likewise, the closeup of the brochure at right; again handheld, point and shoot. Auto focus, auto exposure, auto everything. This could be used for archiving purposes.

thing about the EOS D60 in this brief review – we didn't discover them all ourselves in the week or so we had it. Briefly, though, we'll summarise some of the more important functions:

Autofocus: a 3-point autofocus system is built in – you can choose which of the three points you use or let the camera make the decisions for you. Of course, you can also turn AF off and drive the focus yourself. In the past, there has been some criticism of the amount of battery consumed by autofocus. We didn't find this a problem; we did run the batteries flat by forgetting to turn the camera off, though. (Changing one of the inbuilt settings to auto turn-off after a fixed, settable, time fixed this).

Metering: a triple metering system is at your disposal. The camera can use a 35-zone evaluative metering system, partial metering or centre-weighted metering. You can also override the metering system by ±2 stops in half-stop or one-third-stop increments. Or you can have the camera automatically bracket under, normal and over exposure shots for you. Without film to worry about wasting, why not?

Shooting modes: there are 11 shooting modes programmed in, set from a single dial. Along with a fully manual mode, you can choose from a fully automatic programmed (AE) mode, shutter priority AE for fast-moving scenes, aperture priority AE when you're worried about depth of field – and then there are five modes set by dialling up a pictogram: portraits, close-ups, landscapes, sports and night scenes. That might be thought of as shooting for dummies. Maybe so, but gee it's easy!

Shutter speeds: from 1/4000s to 30s plus bulb.

Drive modes: you have the choice of a conventional single frame (one frame per shutter release) or continuous shooting (á lá a motor drive – up to eight frames at three frames per second). And there's a self-timer built in for good measure.

White balance: once again, manual control where you make the white point decisions, or seven modes of automatic/preset. Pictograms again make it easy – daylight, overcast, tungsten light, fluorescent light, external flash and a custom mode plus a fully automatic mode which allows the camera to react to changing lighting conditions during the shoot.

Canon's "PhotoStitch" utility: Not perfect but gee, it's not bad!

We just had to show you this nifty utility which is on the Canon CD. It allows you to join two pics (digital, scanned, downloaded, etc) in a "panorama" mode. It's very quick and easy to use and while it's not perfect, it does a commendably good job – almost as if shot with a very wide angle lens! You could in theory keep adding photo after photo after photo!

We started with these two building pics, shot from exactly the same spot.

Here's what they would have looked like merely superimposed one on the other. . .

And here's how PhotoStitch joined them. Perspective is a bit strange but otherwise, not a real bad result in smoothing the building lines out. The join is barely visible.

LCD Panel

The LCD panel on the top of the camera, in conjunction with information in the viewfinder, gives even the most demanding photographer every piece of information they could ever want.

Of course there are the things you'd expect: shutter speed, ISO speed, aperture and so on – but there is so much more that we've reproduced the manual graphic to show you.

It'll tell you when your battery is low, the mode you're in, how many shots you've taken/have left, exposure info, drive mode . . . there is very little it doesn't tell you and that is almost certainly taken care of via the rear screen.

Viewfinder

Much of this information, especially the vital stuff, is repeated in the 20mm viewfinder so you don't need to take your eye away from the action to see what the camera is doing. The viewfinder has a –3.0 to +1.0 dioptre adjustment to cater for most eyesight.

Software

We've already mentioned Photoshop Lite – but there are other goodies. Whether you work in Windows or Mac, there is software to make your life easy:

ZoomBrowser EX (Win) or ImageBrowser (Mac) allow you to download, catalog and print your digital pictures.

How much resolution do you need?

We've been extolling the virtues of 6+ megapixel resolution – but obviously that comes at a (significant) price.

Resolution determines image quality – the higher the resolution, the better the final print.

It should be fairly obvious that higher resolution packs more detail into the image than lower resolution. The higher the number of megapixels, the higher the resolution.

First of all, let's look at that term, megapixels. Mega means, naturally, millions of, and pixel is an abbreviation for "picture element".

In the camera, the image sensor doesn't work as a single unit. Instead, it's divided into (usually) millions of individual sensors, each able to react independently to changes in light level (shades) and colours (hues).

Each one of these is called a pixel – and the more pixels in that image sensor, the better the resolution, because more information is provided in the image.

How can you work out what resolution you really need?

To produce a very good (photo-quality) print, you generally need around 300ppi (pixels per inch – yes, it's usually expressed in imperial measurement).

You can get away with less (sometimes 200ppi is used) but quality drops away quite quickly.

It's not too difficult to work out how many megapixels you need.

Once again, we need to work in inches. And all this assumes you are using the total area of the sensor for your enlargement. If you are cropping (choosing only a certain section of the image to enlarge and discarding the rest) these figures get blown right out of the water!

Say you want a high quality, 10x8 print, so you'd choose 300ppi resolution. Multiply both dimensions of the print by 300: 10 x 300= 3000, 8 x 300= 2400. Therefore, your camera needs to produce an image 3000x2400 pixels. Can it? Multiply the 3000 by 2400 and you come up with 7,200,000 or 7.2 megapixels – even beyond the 6.3 megapixel Canon.

Of course, if you are prepared to settle for 200ppi in the final print, the equation becomes 2000 x 1600 or 3.2megapixels.

Perhaps now you can understand why many of those "point'n'shoot" cameras with only a few hundred kilopixels or so produce less-than-satisfactory prints – at virtually any size!

So how does the claim for 16x12 inch from 6.3Mp work out? Theoretically, even at 200ppi that's 3200 x 2400 or 7.7Mp. The answer is in the processing – either within the camera itself, the output device (the digital printer at your local processor's) or in your computer.

Many cameras and most photo-manipulation software have the capacity to "interpolate", manufacturing information from the pixels around it and sort-of "filling in the gaps" with similar information.

It's not perfect, but these days is capable of surprisingly good results if you don't push it too far.

PhotoStitch lets you merge several images together to form one continuous panoramic photo. This software isn't limited to the digital pics from the D60 – it will work with files from any source (even document scans).

RemoteCapture

You can save images direct to your computer rather than the CompactFlash or Microdrive. This is really useful for the large RAW files. It also lets you remotely control the camera (with your PC) to shoot single frame, timer and interval timer (eg, time lapse or unattended). But would you leave your D60 unattended? I know I wouldn't!

The package also includes the cables you're going to need such as a USB port connector, video out (did we mention that the D60 can output to a video monitor?) and power adaptor.

Just for comparison, the same setup done under our Balcar studio flash with the D60 (left) and my trusty old (very old!) Minolta SRT-101 using Fuji Sensia 35mm film, f16, 1/60sec. Shadowing is more pronounced on the Canon.

Power

A rechargeable lithium-ion battery pack is included which is claimed will give a capacity of between 400 and 620 frames, depending on the temperature and whether or not the flash is used.

With the review sample, a battery grip was supplied which takes a second battery, doubling the number of shots. The grip also makes handling the camera in vertical mode much easier. But it will set you back another $280 or so.

One thing we didn't like: with the battery grip in place and the 16-28mm lens fitted, the camera was front-heavy and always fell forward onto the front edge of the lens. Not a big problem, just something to keep in mind. And while on the subject of gripes, the lens cap could not be made captive in any way – and with a lens of this value, you don't want to lose the lens cap.

OK, let's cut to the chase

We've told you all about the camera and what it will do. About the

Digital Camera Tips from SanDisk*

While the basic principles of photography still apply, digital cameras have their own unique characteristics that differ from traditional film cameras.

To compile this advice, SanDisk enlisted the help of Rick Sammon, host of the Digital Photography Workshop on the US DIY Television Network, photography instructor at leading photo learning workshops around the US and author of 21 books on photography. Here are Rick's 10 tips for taking better pictures with a digital camera:

1: Move in closer.

Most pictures will benefit if you take a few steps forward. Having your subject fill most the frame helps your viewer understand your photo and provides details that are often more interesting than an overall view. To get the clearest picture, use the camera's optical zoom if you can't move closer to your subject.

2: Use your viewfinder, not the LCD

A digital camera's LCD screen uses lots of battery power so to maximize battery life, use the camera's viewfinder.

3: Anticipate the moment.

Most point-and-shoot digital cameras have an inherent delay between pressing the shutter button and when the camera takes the picture. Try to anticipate the action and always be ready to shoot.

4: Use available light when possible.

Indoors, the mood created by natural light is lost with a flash. Whenever possible, position a subject by a door or window and avoid using the on-camera flash.

5.Shoot at the highest resolution available.

If you want to print your images or enlarge a part of the image, you'll get the best results from a larger file. You can always decrease the resolution of the image on your computer to email them but starting off with a low-resolution image does not give you the flexibility to print your picture.

6.Take as many pictures as possible.

The more images you take, the better your chances are of getting that special shot. Because you don't incur any costs until you print your images, take as many shots as you can.

7.Delete unwanted images 'on-the-fly.'

Immediately deleting images you don't want minimises the task of deleting images because you're running out of storage capacity. When in doubt, save the image until you can view it on your computer monitor.

8. Use rechargeable batteries.

Digital cameras are notorious for consuming batteries. Consider investing in an extra rechargeable battery. You can continue to take pictures while the other set is charging.

9.Think big.

In most cases, the 8 or 16 megabyte (MB) card that came with your camera won't cut it. Get the highest capacity removable storage card within your budget. For most occasions, a 128MB card will suffice. Rapidly falling prices are making these cards very affordable – having more capacity than you think you'll need lets you concentrate on taking pictures and not filling up the card.

10. Get an external card reader.

One of the easiest and fastest ways to transfer images between the camera and computer is to use a card reader. This is often faster than using the transfer cable included with your camera. In addition, if your camera does not have a docking/recharging station, the card readers avoid tying up your camera and draining its batteries when it is left on for long periods of time while transferring images.

*** SanDisk (www.sandisk.com) is the world leader in removable storage media used in digital cameras, including the "CompactFlash" used in the Canon EOS D60.**

only thing we haven't talked about is what it did for us!

In one word, everything. Everything that we wanted it to do, it did.

We put it through its paces in various modes – as a studio camera (attached to the same Balcar studio flash we use for all our 35mm film photography); as a portrait camera (with flash and without); as a function/event camera (I shot my surf club presentation night with it!); even as a happy snap camera taking various scenes outdoors.

I was tempted to take it along to the State of Origin league match but wiser counsel prevailed . . .

Just for the hell of it, we even shot things like a computer monitor and a printed page in extreme close-up to see how the autofocus and auto-exposure coped (it did!). And we also took it to one of our advertisers who had some bits and pieces he wanted us to see in a very dimly-lit room. No dramas!

Now all this of course only scratched the surface as far as the capabilities of the D60 are concerned. We would have loved to have it for another month (or 50!) to really play with it – but what it did do more than convinced us that it was more than capable of being a very, very versatile workhorse.

Our verdict: more than acceptable. It's a not-so-little ripper, even if you almost have to mortgage the farm to buy it. We said it wasn't the camera for everyone.

But for serious users who want to go the digital route, spec-wise the Canon outperforms the Nikon and Fuji "equivalents"; practically, there doesn't appear to be too much between them (even though we haven't played with the others) and, looking at reported/likely street pricing, the Canon is a little more keenly priced. Not much – but it could be a couple of hundred in your pocket.

By the way, if you are interested in seeing the D60 stacked up against other cameras, Google EOS D60 (and/or Nikon D100/Fuji S2) and you'll be swamped. **SC**

More info:

www.canon.com.au

Acknowledgement:

Our thanks to Alan Brightman of Canon Australia for his assistance in supplying the review EOS D60 (and also a 5-minute ogle at the EOS-1D!).

Also thanks to SanDisk for the use of their Digital Photography Guide.

PC PARALLEL PORT WIZARD

Want to know more about the parallel port on your PC? Maybe you're thinking of buying a second-hand notebook PC. Or perhaps you would like a visual indicator to demonstrate that your printer port responds to software commands. If so, the PC Parallel Port Wizard is just for you!

by Trent Jackson

Getting stuck with a fault in the parallel port of today's computers can be a pain. Wouldn't it be nice to have a simple port tester to check it out. Before you pick up that bargain at the flea market or swap-fest, plug in this Wizard and it will tell you if everything is as it should be.

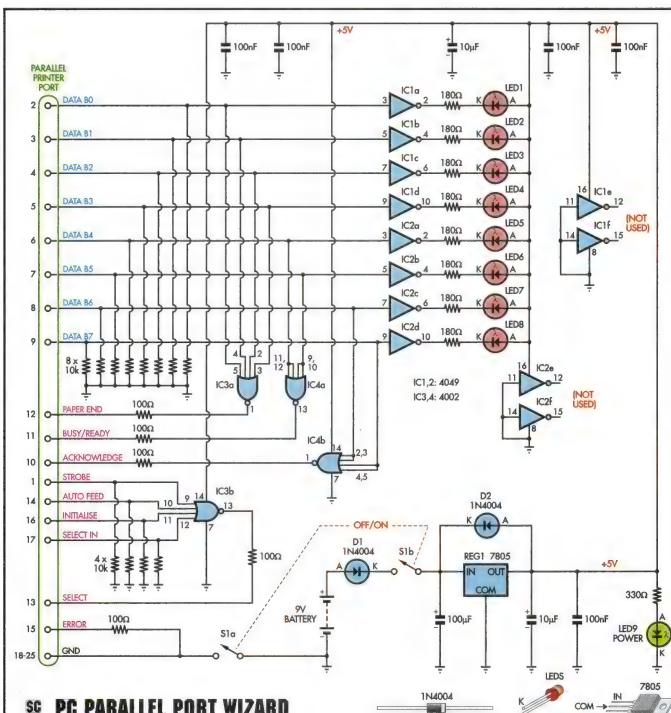
But the Parallel Port Wizard is more than a port testing device. It's also a learning aid. And it's cheap and simple to build. It's a combination of some DOS software and a handful of common components - but it enables you to test and analyse every I/O pin in a standard parallel printer port.

That might not sound very exciting - until you get stuck with a fault. Oh, and before we go too much further we should state what the Parallel Port Wizard will not do.

While it will test every I/O line on the port as an output, to drive a LED, it will not do any input tests. To do that, you would at least need an array of switches to pull the inputs high or low and you would certainly need more complicated software than is presented here.

However, the simple approach can be easily justified. Provided each I/O line functions properly as an output, it is reasonable to assume that it will generally work on data input as well.

So whether your expertise runs to advanced motherboard repairs or just a mere mortal looking to solve a parallel port problem, this Parallel Port Wizard can be a very convenient item.



PC PARALLEL PORT WIZARD

Larger-than-life view of the PC Parallel Port Wizard with top cover removed. The 26-way IDC cabledoesn't emerge from the middle of the case as it appears here; rather it takes a 90° kink then another to emerge from the cutout which can clearly be seen above the battery. This gives some strain relief to the IDC plug, preventing it from being pulled out.

It will analyse every I/O line and give a pass/fail via the software.

The parallel printer port

The parallel printer port on a standard IBM compatible computer consists of 25 pins, usually arranged in a "D" configuration (see Fig.1). 17 of these pins are I/O (input/output), while the remaining eight are ground pins.

Of the 17 I/O pins, eight (pins 2-9) are grouped as an 8-bit output section, another four (pins 1, 14, 16 and 17) are a 4-bit section while the remaining five pins (pins 10-13 & 15) make up a 5-bit input section.

So the parallel port is broken down into three sections and each particular section has its own unique address. This is shown in the port mapping table (Table 1).

Fig.2: Pinning of a parallel printer port connector on a standard PC, looking from the outside.

As mentioned above, the software has been developed to run under the DOS environment.

Using Windows to control devices via a port is bad enough but testing a port properly via the Windows environment is quite difficult.

I'm not suggesting that it can't be done via Windows, but I believe that for this sort of function DOS is still by far the better way.

Hardware

All of the hardware is mounted on a small, single-sided PC board, coded

PIN NO.	ADDRESS	BIT	VALUE	INVERTED	GENERAL USAGE	PRINTER USAGE
2	BASE	0	1	NO	8-bit Output Data	8-bit Output Data
3	|	1	2	NO	|	|
4	|	2	4	NO	|	|
5	|	3	8	NO	|	|
6	|	4	16	NO	|	|
7	|	5	32	NO	|	|
8	|	6	64	NO	|	|
9	|	7	128	NO	|	|
1	BASE + 2	0	1	YES	4-bit Output Data	Strobe
14	|	1	2	YES	|	Auto Feed
16	|	2	4	NO	|	Initialize
17	|	3	8	YES	|	Select In
10	BASE + 1	6	64	NO	5-bit Input Data	Acknowledge
11	|	7	128	YES	|	Busy
12	|	5	32	NO	|	Paper End
13	|	4	16	NO	|	Select Out
15	|	3	8	NO	|	Error

Table 1: the parallel printer port pin assignments and usages. Common BASE addresses are: &H378, &H278, &H3BC. These addresses are in hexadecimal. To simplify things, bit values are shown in decimal

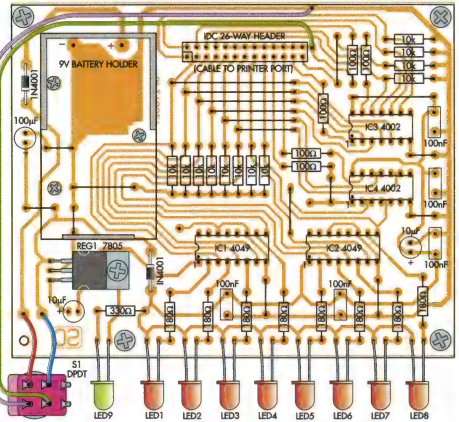
07110021 and measuring 116 x 92mm.

The circuit operation is relatively straight forward. It uses only four low cost CMOS ICs and a few other bits and pieces to do the job. It's all powered by a single, on-board 9V battery.

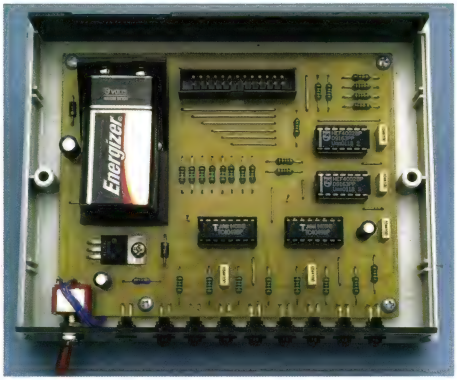
Every pin on the parallel printer port goes somewhere. As stated before, every pin on the port under goes a test (minus the ground pins, of course).

I have deliberately used CMOS ICs in this project, because as far as I'm concerned, if a parallel port can't supply enough line voltage to drive a CMOS gate, then it is probably suspect.

CMOS logic devices require at least 73% of VCC for a valid logic high, that's only about 3.5V for a 5V supply rail.



Above is the complete project – PC board component overlay and external wiring – reproduced at 1:1 scale. Below is a straight-on photograph of the same thing: between the drawing and photo you should be able to work out how it all goes together.



Parts List – Parallel Printer Port Wizard

1 PC board, coded 07110021, 116 x 92mm
1 small ABS case 140 x 110 x 35mm (Jaycar HB-5970 or equivalent)
1 front panel artwork sticker 134 x 30mm
1 miniature DPDT Switch (S1)
1 26-way PC-mounting IDC male header socket
1 26-way IDC female plug
1 25-way D25 male IDC Plug
1 9V PC-mounting battery holder (Jaycar PH-9235 or equivalent)
1 9V alkaline battery
1 1.5m length 26-way IDE ribbon cable
1 200mm length hookup wire
4 small square rubber feet
2 PC stakes
4 6 x 3mm self-tapping screws
1 5mm M3 screw & nut
3 6mm M2 screws & nuts
9 5mm LED bezels
Tinned copper wire (links)

Semiconductors

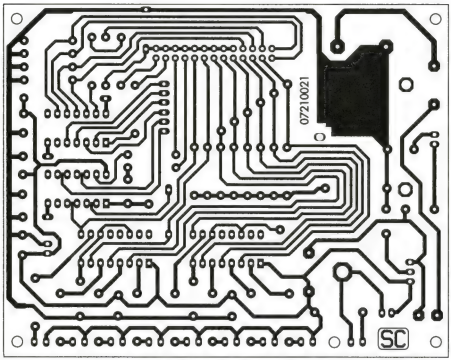
2 4049 CMOS hex buffered inverters (IC1 & 2)
2 4002 CMOS dual quad input NOR gates (IC3 & 4)
1 7805 5 volt regulator (IC5)
8 5mm red LEDs (LED 1 - 8)
1 5mm green LED (LED 9)
2 1N4004 silicon power diodes (D1 & 2)

Capacitors

1 100µF 16VW electrolytic
2 10µF 16VW electrolytic
5 100nFMKT polyester (code 104 or 100n)

Resistors (1%, 0.25W)

12	10kΩ	5	100Ω
8	180Ω	1	300Ω



Same-size PC board artwork for those who want to make their own.

How it works

Referring back to the schematic, you will see four quad-input NOR gates (IC3a, IC3b, IC4a & IC4b). These gates are basically used to return data to the input side of the port. Remember that there are 12 output pins but only 5 input pins on the port, hence the use of four NOR gates.

All five of the input pins on the port are pulled high via internal resistors, so you could regard these pins as being Active low (it really just depends on how you set up the software and hardware.

With a NOR gate, any high logic level on any of its input pins will result in a logic low at its output pin. It's the same as an OR gate, except it's inverted.

The 10kΩ pull-down resistors on all the output lines are there for two reasons. Firstly, they ensure that none of the inputs to the logic circuitry are left floating when disconnected from your PC.

Secondly, they also apply a small load to the output lines, to ensure that they are still capable of driving the data feedback NOR gates while under load.

IC1 & IC2 are both 4049 buffer inverters. These buffers drive a string of eight LEDs, controlled via (D0 - D7) on the port. The 180Ω series resistors limit the current the LED current to around 20mA.

A double-pole switch controls both power and port grounding to the circuit. Switching of the port ground to the main circuitry has been included so that the circuit doesn't consume any power from the port when various data lines are high and the battery voltage is not applied.

If this switch was omitted, you would see the LEDs faintly light up with no power applied. This is due to current mirroring within CMOS devices.

Construction

As everything except the power switch mounts on the PC board, construction should be a snap even for the beginner. Start with the lowest profile components first (resistors and diodes), followed by the links. We normally use resistor lead offcuts for the links but some on this board are a tad long, so you'll need some lengths of tinned copper wire.

Two PC stakes are used to solder to the switch. Four stakes are shown in our photos but two of these were used in development and are not required.

Next, mount the five MKT and two electrolytic capacitors. The MKTs aren't polarised but the electros are, so put them in the right way.

Follow these with the 5V regulator (you'll need to bend its legs down by 90°) and the four ICs.

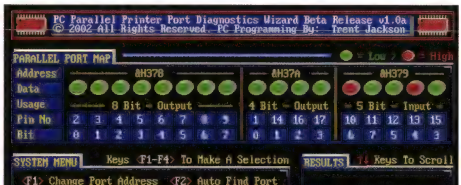
Whether you use sockets or not is entirely up to you: generally, they're not worth the trouble with low-cost chips. Either way, make sure you get the IC polarity right.

Now mount the 9V battery holder. It both solders and screws to the PC board. Then install the male IDC plug.

Apart from the switch and LEDs, it's now almost finished. First, though, you'll need to drill ten holes in the front panel for the nine LEDs and the power switch. Photocopy the front panel artwork and use it as a template.

The LED leads must also be bent over at 90° to enable them to poke through the front panel. Make sure they are all bent the same way AND the right way – LEDs are polarised!

Glue the front panel artwork (or a photocopy) onto the panel and drill the holes out. And don't forget the little cut-out in the back panel. LED bezels are not essential - but they do hide any



The ppwiz.exe software, downloadable from www.siliconchip.com.au

This front panel artwork can also be used as a drilling template. Photocopy it, stick it on the front panel – and drill out the 'X's!

ragged or rough edges around the holes.

Fit the switch to the front panel and solder its two lower pins to the PC stakes. The two upper switch pins solder to the back of the PC board where shown.

Finally, screw in the PC board, plug in your IDC cable and take it out the rear panel (don't forget the double bend!) and now it IS all finished.

Using the PPP Wizard

As stated elsewehre in this article, the Parallel Port Wizard and its software operates under MS-DOS. That means you either have to boot the computer with a DOS disk or if you have a Win 9x or Win Me machine, operate it under a DOS (command prompt) box.

In either case, checking the parallel port is child's play.

You simply plug the wizard in to the parallel port, turn it on and run the PPWIZ.exe program.

All instructions are on screen.

The F1 key allows you to change the base port address, the F2 automatically searches for the base port address, the F3 key starts the automated checking procedure while the F4 key exits from the program (see the screen grab below).

The 8-bit pin status is mirrored by the front-panel LEDs on the Wizard. While this is of limited use in the port checking procedure, it becomes very useful when you want to experiment with the port.

Have fun! **SC**

Putting the port to use

Would you like to be able to control external devices with your PC?

The existing parallel port in your PC offers a simple hardware interface that can be wired up to just about any external device with a little ingenuity.

And it's easy to program, too!

The PPPWiz hardware and software provides a means of learning the basics of parallel port operation. With this knowledge, you can then begin to control the port (and your external circuits) from within your own programs.

In the following examples, we show how to read and write data from the parallel port using QBASIC. We've used QBASIC because it's easy to follow if you're new to programming.

For the most part, data is read from and written to the parallel port in byte-wide (8-bit) chunks. To access the port (read and write data), the programmer needs to know its "address".

Just as with disk drives, keyboards, serial ports, etc, the parallel port occupies a unique address in the processor's (CPUs) input/output (I/O) address space. For example, the address of the first parallel port (LPT1) in most PCs is 378 or 278.

Thus the parallel port is said to be "I/O mapped" and is accessed in QBASIC using the "INP" and "OUT" instructions.

Too easy!

Note that these numbers are in hexadecimal format. In QBASIC, hexadecimal numbers must be prefixed with "&H". Here's an example:

```
OUT &H378, 0      'write data value '0' to I/O port '378'.
```

The data output side of the port consists of an 8-bit latch (or "register"). Therefore, data written with the OUT instruction remains on the port data pins (pins 2 - 9) until the next OUT. To drive all eight pins high (near 5V) we would use:

```
OUT &H378, &HFF   'write data value 'FF' to I/O port '378'.
```

With the PPPWiz connected, this instruction will turn all LEDs on.

To read the digital levels present on the port "status" pins, use "INP" instead:

```
PortValue = INP (&H379)   'read data from I/O port '379'.
```

In this example, the digital levels of the "status" pins (pins 10 - 13 & 15) are read and stored in the variable "PortValue". Displaying the result is easy:

```
PortValue = INP (&H379)   'read data from I/O port '379'.
PRINT PortValue           'display the value on-screen
```

A parallel port occupies eight consecutive addresses in I/O address space. The first address (the output port) is referred to as the "base" address. Therefore, when a parallel port is said to have an address of 378, this implies that it occupies addresses 378 through to 37F.

Table 1 gives specific details about addresses and pin assignments as they relate to the standard parallel port (SPP). Parallel ports fitted to most Pentium-class PCs can also operate in EPP (Enhanced Parallel Port) and ECP (Extended Capabilities Port) mode. These modes use additional addresses and signals not covered in this article.

A wealth of PC parallel port technical information and project ideas is available on the Internet.

Start at **www.lvr.com/parport.htm**

QBASIC was supplied with all versions of DOS and Windows up to (but not including) Windows 2000. It is also freely available on the Internet. To learn more about QBASIC programming, go to **www.qbasic.com**

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- Plug in leads

See cat. page 180 for full details.

NEW PRODUCT

Cat. QM-1495 $9.95

RS-232 Auto Ranging DMM

NEW PRODUCT

This feature packed DMM has an RS-232 connection for PC interface. CD-ROM software is supplied for data transfer and logging. This meter features
- 3.75 digit •3999 Count
- Capacitance •Frequency
- Temperature
- Auto Ranging •Duty cycle
- Data hold
- Relative measurement
- Software data logging
- CD-ROM included
- Rubber holster included

See cat. P182 for specs.

Cat. QM-1538 $69.95

Melcom 8 Sector Alarm Panel with LCD Keypad

Melcom Alarms are designed in the UK, and offer excellent value for money. This alarm has an illuminated LCD keypad, which makes set-up, programming and operation easy.
- Zone naming capability
- Programmable entry/exit time
- Up to 6 programmable user codes
- Personal attack button sequence located on the keypad.
- "Sleep Watch" mode with remote keypad.

Too many features to list them all! See Cat. Pg. 167 for full details and specifications.

NEW PRODUCT

Cat. LA-5320 $299

Extra LCD Keypads Available
Cat. LA-5321 $149.50

Sleep Watch Remote Keypad with Panic Button for Melcom Alarm

'Sleep watch' mode enables you to disarm selected internal sectors while maintaining perimeter security and includes a panic button.

NEW PRODUCT

Cat. LA-5323 $69.95

Probe Style DMM

Take measurements without having to look away from where your test probes are. It makes readings from IC's, and Surface Mount Components easier and reduces the risk of shorting pins or tracks. Includes a probe cap to protect from damage
- 3.5 digit •Data hold •Diode test •AC/DC voltage
- DC current •Resistance

See cat. page 187 for specs.

NEW PRODUCT

Cat. QM-1497 $29.95

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An excellent alarm system for larger houses and those who want a top quality system at an affordable price. This system would cost a fortune if it was fitted by a specialist installer. Do it yourself and save a bundle! The kit includes:
- 1 x 8 Sector Melcom Alarm Panel •3 x Micron Pulse Count PIR
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- 1 x Siren Horn •1 x Plug Pack Power Supply
- 1 x 12V 1.3AH SLA Battery •1 x 100M 6 Core Alarm Cable
- 1 x Strobe Light •1 x Siren Cover
- 1 x Internal Siren

•Save $152 on normal parts prices!

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Features an extra large 25mm high digit display, and an inductance meter up to 20H. This is a full featured meter with resistance reading up to 20M ohm, 10A current rating, 200uF capacitance and an 800°C temperature probe.
- 3.5 digit •1999 count
- Capacitance •Transistor Test •Temperature
- Inductance
- Rubber holster included

See cat. page 182 for details and specs.

Cat. QM-1445 $64.95

Universal 8 in 1 Pre-Programmed Remote Control

With Teletext and Changeable Faceplates

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Change your remote to suit your décor, just like many mobile phones. This remote comes with two extra changeable faceplates, and can control up to 8 different appliances. It is pre-programmed to suit over 35,000 different pieces of equipment.

Supplied with Black, Silver and Gold coloured face plates.

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Never before at such a fantastic price! External unit has a B&W CMOS Camera with Infra-Red Illuminators, to see your visitors in complete darkness. The internal unit features a 4" monitor with telephone handset. Speak to a visitor before letting them in. You can connect another monitor, or even 2 more to this unit. This unusual feature, normally only found on expensive professional units enables you to answer the door from virtually anywhere in the house/factory! Will also operate an electronic door strike (Cat LA-5078).

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Aluminium Torches with a Magnifier Lens

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NEW PRODUCT

This versatile, solar powered light is ideal as a highly visible personal warning light for joggers, a breakdown warning light for your car or a clearance light for obstructions or railings etc. Will operate for 24 hours with just 2 hours exposure to full sun.

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Contains 25 of the most popular sizes in a combination of 21 square belts from 23mm to 120mm and 4 flat belts from 56mm to 93mm.

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Cat. HP-0652 $12.95

Super Bright Halogen/LED Torch

This halogen hand torch is so bright it's scary!
Halogen globes are much brighter than filament or Xenon globes. It also includes a LED, to provide efficient, reliable light when the halogen power is not required. Features aluminium case, carry strap, nylon bag, an adjustable beam, a pushbutton on off switch, and a small size for the light output, only 170mm long. 4 AAA batteries included.

Cat. ST-3328 $49.95

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2 Gauge Gold Plated Power Terminal

You wanted it, and here it is! This power terminal has an 8mm mounting hole for mounting on a bolt or on our gold battery terminals to run 2GA cables to equipment.
•Length 57mm

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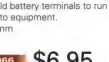

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Ideal for etching PCB's up to 200 x 250mm in size. The tank is thin, so it uses less solution to cover more area. Suitable for single or double sided PCB's. PCB Clips and hooks are provided, so inserting and removing your PCB's in the solution is easy. Supplied with stands which can be screwed to a bench for extra stability.

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Pkt. 4

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New Pre-Built Subwoofer Enclosures

Sealed Subwoofer Enclosures

These subwoofer cabinets are made from 15mm chipboard and are supplied fully assembled. They are covered in grey carpet, have pre-cut speaker holes, gold plated speaker terminals, and ports already mounted (where applicable). With most of the work already performed, all that is required is a sheet of innerbond luse our AX3690), a length of wire to solder the speaker to the terminals, screws and a screwdriver to secure the speaker in. Despite the very low price, these are very strong and sturdy boxes. These are generic sized boxes, internal volumes are 25L for 10" box, 35L for 12" box, and 45L for 15" box. They will accept some of our woofers, but we recommend a bass box computer program for optimum results. The applications for these enclosures are not limited to automotive audio use, other uses include, foldback, P.A and home hi-fi subwoofer enclosures.

Outside Dimensions: 25 Litre Box 340 x 455 x 250mm / 35 Litre Box 375 x 455 x 310mm 45 Litre Box 465W x 515H x 310Dmm

10" 25 Litre Cat. CS-2520 $59.50
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Adjustable ports to assist box tuning.

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Miniature Tripod

A handy tripod for cameras which extends from a compact 14cm up to 27cm using its telescopic legs. It has a standard camera mount, 360° swivel angle mount and handles up to 2kg loads. Ideal for travellers or for those who take long exposure stills.

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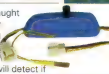
CPU Fan Alarm

NEW PRODUCT

Don't get caught with a faulty CPU cooling fan in your computer. This alarm will detect if the fan is not connected or has stopped running and alert you with a loud warning signal, allowing you to shut the computer down & prevent the CPU from overheating. Includes built-in volume adjustment and measures 60(L) x 18(W) x 23(H)mm



Cat. XC-5032 $13.95

Mini USB Optical Mouse

This mini optical mouse measures only 65(L) x 30(W) x 15(H)mm. Connection is via USB port, and is compatible with PC and MAC.

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It will work on virtually any surface including your laptop wrist rest.

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- 90Min
- Up to 48 speed
- Suitable drive required

NEW PRODUCT

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100 Pack CD-Rs

- 700Mb
- 80Min

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Cat. XC-4726 $54.95

CPU Cooler for AMD/INTEL Processors

Don't run the risk of an overheating CPU. This high power CPU cooler features a super high speed 5000-7000RPM cooling fan, and a high efficiency heatsink. It is supplied with 25% Pure Silver Heatsink compound which has much better heat transfer than standard compounds. Compatible with AMD/Intel processors of all speeds.

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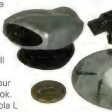
This handy device will enable you to store, edit, and add details from your PC to the Phonebook on your mobile phone. Compatible with many of the popular mobile phones which support InfraRed data transfer, it will enable easy maintenance of your mobile's phonebook.

- Supports: Motorola L series, Nokia 8210, 8250 Ericsson 8 series, Siemens S25 series



Cat. XC-4831 $79.95

32 Pocket DVD Wallet

NEW PRODUCT

Here is a compact & convenient way of carrying your valuable DVD collection from place to place. The wallet has 32 sleeves designed to hold a DVD on one side and the insert on the other, so you will always have the printed information at hand. The zippered wallet has a soft leather look finish and has a secure carry loop on the spine. Measures approx 230 (W) x 245 (H) x 70 (D)mm

Cat. AR-1491 $39.95

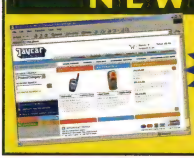
PC Security & Encryption Key

NEW PRODUCT

Secure your PC against unauthorised use. This tiny device is no bigger than most car keys, yet when installed on your computer gives you total control over machine security. The system uses a hardware key that plugs into your USB port and software, supplied with the package to provide high-level security of encrypted files, logons, and dial-up.

Cat. XC-4838 $399

NEW JAYCAR WEBSITE



Have we got your attention? It's online 1st October.

Our new "State-of-the-Art" Jaycar website. With increased focus on easy ordering and product information.

NEW IMPROVED FEATURES:

- √ Express Ordering
- √ Faster
- √ Advanced Searching
- √ Trade Pricing
- √ New Zealand Pricing
- √ Easier Navigation
- √ Software Downloads
- √ Media Releases
- √ Over 3,247 pages of semi-conductor data with search

OVERNIGHT DELIVERY AVAILABLE*

Can't make it to one of our stores - then let our store come to you!

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www.jaycar.com.au

New Additions to Our High Quality *ConCord* Audio Video Leads

We have now expand our existing range of Concord A/V leads to cater for the longer runs between equipment. All still feature gold plated contacts, shielded plugs, and offer excellent signal reproduction.

NEW PRODUCT

RCA Plug - RCA Plug-3m
Cat. WQ-7223 $11.95
RCA Plug - RCA Plug-5m
Cat. WQ-7224 $14.95
RCA Plug - RCA Plug-10m
Cat. WQ-7225 $19.95
3 x RCA Plugs - 3 x RCA Plugs - 1.5m
Cat. WQ-7238 $29.95 Component RGB
3 x RCA Plugs - 3 x RCA Plugs - 3m
Cat. WQ-7240 $34.95 Component RGB
3 x RCA Plugs - 3 x RCA Plugs - 5m
Cat. WQ-7237 $39.95
3 x RCA Plugs - 3 x RCA Plugs - 10m
Cat. WQ-7235 $49.95

18 Hour Digital Voice Recorder

NEW PRODUCT

This incredible digital voice recorder will store up to 18 hours of voice quality audio in a neat, slim & very small hand-held unit. 4 separate message groups are available and each group can have up to 99 messages. You can also download the recorded messages to your PC via your computer's sound card and edit them with the software supplied. Accessories include an earphone, line out cable and a telephone adaptor. However, the telephone adaptor is NOT approved for use in Australia/NZ.
•Recording Time: 18 hours •Size: 26W x 110H x 18Dmm •Weight: 33g (Without batteries)

Cat. XC-0281 $299

9 Hour Digital Voice Recorder with USB interface

NEW PRODUCT

Similar to our XC-0281 digital voice recorder. Featuring almost equivalent operation and function, with the added advantage of a high speed USB connection to your computer. You can download the recorded messages to your PC via the USB interface and edit them with the 'Voice Wizard' software supplied. •Recording Time: 9 hours •Size: 26W x 110H x 180mm •Weight: 33g (Without batteries)

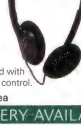
Cat. XC-0282 $299

Scoop Purchase on High Quality Headphones

Features a 5metre extra long lead with individual volume control, and a 3.5mm gold plug. The headband is lightweight, fully adjustable and has cushioned ear pads. Excellent value at only $8.95ea

NEW PRODUCT

Supplied with volume control.



Cat. AA-2001 $8.95ea

Low Capacitance A/V Connecting Cable

NEW PRODUCT

3 x RCA to 3 x RCA Plugs
•10 metres long.

Cat. WV-7321 $19.95

500WRMS 'Class D' Subwoofer Amplifier Module

State of the art 'Switching' technology makes this 'Class D' amplifier perfect for any home installation. See page 233 of the Jaycar Catalogue for full details. Limited Qty.
Was $799 Save $200

Cat. AA-0510 Now $599

Piano Finish Centre Speaker

Designed for surround sound applications, the cabinet has a power rating of 60WRMS and houses a 1" tweeter & 2 x 5" woofers. Magnetic screening makes this speaker ideal for TV top mounting. Ideal as a centre speaker in home theatre situations and will compliment any décor.
Was $159 Save $20

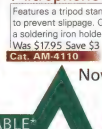
Cat. CS-2450 Now $139

Home Unit Subwoofer 30WRMS 6.5"

The inbuilt amplifier is rated at 30Watts RMS and drives a 6.5" speaker to give solid low frequency enhancement in your home theatre or stereo system. See Cat P233 for details and specs.
Was $169 Save $20

Cat. AA-0512 Now $149

350W RMS Subwoofer Amplifier Module with Remote Control



Loads of power, adjustable sensitivity, adjustable crossover frequency and even an infrared remote control. Supplied with a remote transmitter and a receiver that incorporates motorised controls for level and crossover frequency.
•350 watts RMS into 4 ohms & 240 watts RMS into 8 ohms •Frequency response: 20 to 160 Hz •Adjustable crossover: 50Hz to 160Hz •See Cat Pg 234 for Details.
Was $429 Save $40

Cat. AA-0508 Now $389

Desktop Stand with Microphone Holder

Features a tripod stand, and rubber grips to prevent slippage. Can also be used as a soldering iron holder. See Cat P249.
Was $17.95 Save $3

Cat. AM-4110 Now $14.95

6.5" XL RESPONSE Split Speaker / Coaxial Combination

The adjustable 20mm dome tweeter mounts on the woofer just like regular coaxials, though with a quick twist, you can remove the tweeter and mount it separately. Supplied with 2-way crossovers and wiring. Power handling 60W max (40WRMS). See Cat P253.
Was $119 Save $20

Cat. CS-2296 Now $99

Digital Sound Level Meter

Features include data hold, high and low range (35 – 100dB and 65-130dB), and a built in calibration circuit. Powered by a single 9V battery (included) and supplied with a foam insert zip-up carry case, complete with shoulder strap. See Cat page 194 for details.
Was $179.50 Save $20

Cat. QM-1588 Now $159.50

Extra Heavy Duty Speaker Tripod Stand

This rugged stand extends to just under 2 meters and will support up to around 45Kg. It features tough, non slip rubber feet, a "stopper-rod" to stop heavy loads sliding the shaft into the base, and is made from strong aircraft grade aluminium. See Cat Pg 240 for details.
Was $109 Save $10

Cat. CW-2860 Now $99

Unidirectional Wireless Tie Clasp Microphone

Transmits to a standard FM receiver. See Cat. Pg. 248 for Details.
Was $32.95
Save $5

Cat. AM-4068 Now $27.95

Fig 8 OFC Screened Audio Cable

High quality shielded cable for excellent reproduction.

NEW PRODUCT

•Inner Conductor: 0.12mm OFC.
•Insulator: FPE Red/White
•Shield: 14mm Aluminium foil, straight screen.
•25 x 0.12mm strands

$3.25m or $96 per 40m roll

Cat. WB-1506

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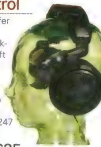
Digital Monitor Headphones with Volume Control



These monitor headphones offer clear and precise sound reproduction. They feature click-type headband adjustment, soft padded ear cups, single side cable entry, an in-line volume control and a 2.9 metre lead with gold plated 3.5mm stereo plug. A 3.5mm to 6.5mm adaptor is included. See Cat P247 for specs. Was $45 Save $10

Cat. AA-2009 Now $35

UHF Wireless Stereo Headphones

These 433Mhz wireless headphones incorporate the latest RF technology to provide personal listening freedom with great sound, and a range up to 50 metres. The supplied 2 x AA NiCad rechargeable batteries powering the unit, can be charged by plugging the headphones into the transmitter when not in use. See Cat P247 for specs. Was $109 Save $10

Cat. AA-2000 Now $99

Extra Heavy Duty Fig 8 Speaker Cable 30m Roll

Cable is 2 x 79/0.2mm for high Power installations.

Was $59.95 Save $15

Cat. WB-1713 Now $44.95

Neutrik "Speakon" Loudspeaker Connectors

Heavy duty, fail safe speaker connectors. 4 Pole. Up to 30A continuous current. See Cat. Pg. 59-60 for details.

Inline Plug Was $14 Save $1.05

Cat. PP-1090 Now $12.95

Square Chassis Skt Was $8.95 Save $1

Cat. PS-1092 Now $7.95

Round Chassis Skt Was $8.95 Save $1

Cat. PS-1094 Now $7.95

JV60 Home HI FI Speaker Kits

Jaycar's last batch of JV60's Get them before they are gone! The JV-60's use VIFA speakers, made in Denmark. Each cabinet houses 2 x 6" drivers, and a 1" metal dome tweeter and offer 100WRMS power handling. They sound as good as built speakers costing twice as much! The cabinets are pre-built in black veneer MDF and have all the holes cut, ready for fitting the drivers. Call into any Jaycar store for a demonstration. See Cat Pg 230.

Speaker and Crossover Kit - Pair

Cat. CS-2560 $569

Pre-Built Cabinets – Pair

Cat. CS-2562 $349

Complete Kit – Pair

Cat. AA-0129 $889

Coax Crimping Tool Kit

Professional Coax Plug Crimping Tool Kit The Kit Includes a Crimper with 5 interchangeable dies, cable cutter, coax stripper, screwdriver for changing dies, and a plastic carry case to keep it all together. See Cat page 212 for details Was $169 Save $30

Cat. TH-1878 Now $139

New Battery Holders – Snaps

10 x AA Battery Holder	Cat. PH-9210	$2.95
4 x D Lantern Style	Cat. PH-9224	$4.95
9V Battery Snap Safety High Quality	Cat. PH-9233	$0.75
We call these safety clips because the side of the clip totally covers the battery terminals & sits flush on the top of the battery.		
9V Battery Snap T Safety High Quality	Cat. PH-9234	$0.75
9V Battery Holder Metal	Cat. PH-9237	$0.50
9V Battery PCB Clips Pair	Cat. PH-9239	$1.20
PCB mount pins to suit a 9V battery. Supplied as a pair.		
1 x AAA – Wire	Cat. PH-9260	$0.60
1 x AAA – PCB	Cat. PH-9261	$0.60
2 x AAA – PCB	Cat. PH-9264	$0.85
4 x AAA - Wire	Cat. PH-9268	$1.85
4 x AAA – PCB	Cat. PH-9270	$1.85
2 x AA Switched Enclosure	Cat. PH-9280	$1.50
4 x AA Switched Enclosure	Cat. PH-9282	$2.25
2 x AAA Switched Enclosure	Cat. PH-9288	$2.20

Anti-Static Field Service Mat/Bag

This mat is ideal for field service people, it folds out to reveal a work area of approximately 600 x 600mm. At one end there are 2 pouches, with a ground lead and wrist strap supplied.

Was $44.95 Save $10

Cat. TH-1776 Now $34.95

Professional Cat 5 Cable Termination Kit

This kit comes in a tough yet attractive zippered fabric case. Ideal to cut, strip, terminate, and test Cat 5 cables. Individual contents would cost much more than this kit. See Cat Pg 212 for what's inside!

Was $199.95 Save $20

Cat. TD-2092 Now $179.95

Vacuum Bench Vice with 75mm Jaw

This robust, hardwearing bench vice features a powerful suction base for portability, removable soft rubber jaw covers with 'V' grooves for holding cylindrical and irregular shapes, and 360° jaw angle. Was $57.95 Save $8

Cat. TH-1766 Now $49.95

6 Piece Precision Tamperproof Torx Set

Quality Chrome Vanadium Drivers consisting of T7, T8, T9, T10, T15 and T20. All drivers are 145mm long and presented in a felt lined case. Was $17.95 Save $3

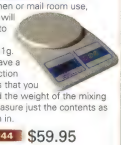
Cat. TD-2021 Now $14.95

Mini Pocket Scales

Not much bigger than a packet of cigarettes, with a maximum capacity of 500grams and a resolution of 0.1gram. Features tare function, low battery warning, auto power off and will measure in ounces too. 140(L) x 80(W) x 30(H)mm.

Cat. QM-7247 $199

2Kg Digital Scales



Ideal for kitchen or mail room use, these scales will measure up to 2kg with a resolution of 1g. The scales have a 'tare off' function which means that you can disregard the weight of the mixing bowl and measure just the contents as you put them in.

Cat. QM-7244 $59.95

Grinder/Mini Drill/Engraver

Fits neatly in the hand

(110mm long)

It houses a powerful 12VDC motor. Use as an engraver and miniature grinder. Supplied with 2 grinding wheels, one engraving burr, a 10mm HS steel PCB drill and 2 brass collet chucks. 9-12VDC source required. Was $29.95 Save $5

Cat. TD-2485 $24.95

Heavy Duty Wire Stripper/Cutter/Crimper

The Alloy Steel jaws can strip all types of wire from AWG 10-26gauge (0.13-6mm). Incorporates a precision cutting blade for easy wire cutting, and quality crimping jaws for insulated/non insulated terminals. Was $25.95 Save $5

$20.95

Cat. TH-1826

USB Powered Notebook Light

Use this USB port powered light when looking inside a computer, or when on the road with a laptop. Twist the head to turn On/Off, has a gooseneck for universal angle adjustment.

NEW PRODUCT

Cat. ST-2808 $19.95

CCTV Camera Brackets

NEW PRODUCTS

Small Professional CCD Camera Mounting Bracket
This small yet strong bracket allows any of our Professional Cameras to be easily mounted to any suitable surface. Length: 120mm
Cat. QC-3332 $8.95

Ceiling Grid Mounting Version
Similar to QC-3332, but will mount into the Ceiling Grid of most office & corporate buildings. Length: 100mm **Cat. QC-3333** $9.95

External CCD Camera Housing Mounting Bracket
This heavy-duty aluminium bracket is designed to mount our large indoor/outdoor professional camera housing and professional range of CCD cameras. Length: 290mm **Cat. QC-3337** $29.95

Roof Mountable Camera Housing Bracket
This heavy-duty aluminium bracket is designed to mount our large indoor/outdoor professional camera housing and our range of Professional CCD cameras. Total length: 700mm **Cat. QC-3338** $49.95

External CCD Camera Housing Mounting Bracket
This strong aluminium bracket is designed to mount our Professional Internal/External Camera Housing. Length: 210mm
Cat. QC-3339 $29.95

New Alarm/Entry Warning Systems

NEW PRODUCTS

Each of these alarms/warning systems can be installed in just minutes. They are all self-contained, and run on 3 button cells (supplied). The modules and reed switch assemblies can all be mounted with the double sided tape (supplied).

Mini Door/Window Alarm
This small alarm module mounts on a window or door and is triggerd by a reed switch/magnet assembly when either a door or window is opened. Mounted in just minutes, once triggered, the incredibly loud siren will sound. **Cat. LA-5004** $17.95

Melody Mini Entry Alarm
This self-contained alarm provides an effective warning of entry by way of simple melody. Suited for the home or office. One of twelve different melodies are cycled each time the alarm is triggered. **Cat. LA-5006** $17.95

Glass Break Mini Entry Alarm
This module can be used as either a glass breakage detector or as a door/window alarm. The alarm could be fixed to, say, a sliding glass door, and depeding on the level of protection you wanted; simply select the desired option via slide switch.
Cat. LA-5008 $19.95

CCD Camera Extension Cables

The leads have 3 joined cables, BNC plug to plug, RCA plug to plug, and DC power male to female. The video cable is quality RG59U, and power is 24 gauge for 5-10m and 18 gauge for 15-20m.

5m
Was $21.95 Save $3
Cat. WQ-7275 Now $18.95

10m
Was $32.95 Save $5
Cat. WQ-7276 Now $27.95

15m
Was $46.95 Save $7
Cat. WQ-7277 Now $39.95

20m
Was $56.95 Save $9
Cat. WQ-7278 Now $47.95

Remote Control A/V Selector Scanner

A versatile 4 way Audio/ Video source switcher that supports both RCA and S-Video plugs. Ideal as a low cost CCD switcher, it also suits home theatre applications. Includes AC Adaptor and Remote.
Was $119 Save $20
Cat. AC-1670 Oct $99

24Hr Time Lapse Video Recorder

If you don't need the extra features of the 960HR Time Lapse VCR, then this model will do the trick.
Limited Quantity

Features include 24Hr Recording, High Resolution, and One Shot Recording (1,2,or 3 minute intervals).
See Cat Pg 275 or ask in store for details.
May be store Display Model.
Was $899 Save $200
Cat. QV-3050 $699

OUR ERINA, GOLD COAST & RINGWOOD STORES ARE NOW OPEN SUNDAYS 10 TO 4

Remote PIR Detector with Wireless Siren

Can be used as either a glass breakage detector or as a door/window alarm, consists of a PIR detector that transmits a trigger signal to a remote siren unit, with a transmission range of approx 30m. Activation via on/off switch on side of remote siren. Being a remote unit, this alarm is ideal for the garage or garden shed, whilst still having the siren close by. Runs off batteries or mains plugpack (not supplied).
Cat. LA-5190 $59.95

Wireless CCD B&W Camera & Monitor

An excellent surveillance system that sets-up in minutes! Infrared LED's for night monitoring and audio transmission both standard features. Excellent performance with 100m line of sight range. See Cat Pg 275 for full details and specs.
Was $359 Save $30
Cat. QC-3450 $329

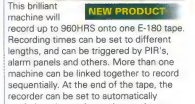
Wireless Home Alarm System

NEW PRODUCT

Buy in October and receive an Extra Remote Control (Cat. LA-5461) worth $42.95 absolutely FREE!

Wireless security systems are an attractive alternative to wired systems; especially for those who rent their home or who live where passing wires through wall cavities is not feasible. The system boasts the latest in wireless security technology. Includes Alarm panel, 2 PIR's, 1 Reed switch, wireless remote control, 240v plugpack and comprehensive manual. For more details see page 171, 2002 catalogue. Extra PIR's available.
Cat. LA-5460 $449

960Hr Time Lapse VCR



This brilliant machine will record up to 960HRS onto one E-180 tape. Recording times can be set to different lengths, and can be triggered by PIR's, alarm panels and others. More than one machine can be linked together to record sequentially. At the end of the tape, the recorder can be set to automatically rewind, and record over the previous recording, or to simply eject.
•Up to 960HR record time.
•Four Head Helical Scan Azimuth System

NEW PRODUCT

Cat. QV-3053 $899

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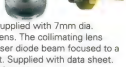
10mW Laser Diode + Collimating Lens

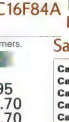


10mW laser diode component, red in colour and supplied with 7mm dia. collimating lens. The collimating lens keeps the laser diode beam focused to a narrow point. Supplied with data sheet. Note: Static Sensitive. Size: TO-18 (5.6mm dia)

Was $19.95 Save $5

Cat. ZD-1954 Now $14.95

USB Solder Plugs



Type A and B USB Plugs with solder lugs.

NEW PRODUCT

Type A

Cat. PP-0790 $1.85

Type B

Cat. PP-0792 $1.85

Wafer Card with PIC16F84A + 24LC16B Inbuilt

Popular with Smart Card programmers.

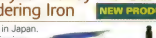
NEW PRODUCT

1+ $19.95
10+ $17.70
25+ $15.70

Cat. ZZ-8800

25% Silver Heatsink Compound

NEW PRODUCT

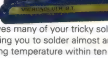


Contains 25% Silver for more efficient heat transfer than standard compounds. Please note that Silver Heatsink Compound does conduct electricity and care should be taken when being used.

Cat. NM-2013 $4.95

Kotelyzer Handy Pro Gas Soldering Iron

NEW PRODUCT



Made in Japan. Superior iron is compact, easy to handle, and doubles as a hot blower and flame torch. With a protective cap with pocket clip. 1mm soldering iron tip, hot blow tip and instructions. Equivalent to electric iron 20-80 watts, approx 500°C. Hot Blower: 650°C

Cat. TS-1280 $69.95

Battery Powered Soldering Iron

NEW PRODUCT

Powered by just 3 x 1.5V AA batteries, this quality Japanese made 6-watt soldering iron solves many of your tricky soldering applications enabling you to solder almost anywhere. It heats to soldering temperature within ten seconds and boasts an approximate 60-min run time. Requires 3 x AA batteries (not included). Includes 0.25mm tip, cap and tip remover

Cat. TS-1286 $74.95

Open Frame Switchmode Power Supplies

Check out our fantastic new low prices!

Features: High efficiency, high reliability, built-in EMI filters, current limiting and over-voltage protection. 1 Year Warranty. Note: These are not stand alone units. They have exposed 240V terminals. They are designed to be mounted inside secure, earthed cabinets.

Cat. MP-3102	**12VDC 25 Watts**	Was $79	**Now $59**	Save $20
Cat. MP-3103	**24VDC 25 Watts**	Was $79	**Now $59**	Save $20
Cat. MP-3104	**12VDC 40 Watts**	Was $95	**Now $75**	Save $20
Cat. MP-3106	**24VDC 40 Watts**	Was $95	**Now $75**	Save $20
Cat. MP-3107	**12VDC 60 Watts**	Was $109	**Now $79**	Save $30
Cat. MP-3108	**5V/12VDC 60 Watts**	Was $109	**Now $85**	Save $24
Cat. MP-3109	**24VDC 60 Watts**	Was $109	**Now $79**	Save $30
Cat. MP-3110	**12VDC 150 Watts**	Was $145	**Now $109**	Save $36
Cat. MP-3112	**15VDC 150 Watts**	Was $145	**Now $109**	Save $36
Cat. MP-3114	**24VDC 150 Watts**	Was $145	**Now $109**	Save $36
Cat. MP-3121	**12VDC 100 Watts**	Was $129	**Now $95**	Save $34
Cat. MP-3122	**24VDC 100 Watts**	Was $129	**Now $99**	Save $30
Cat. MP-3123	**5V/24VDC 120 Watts**	Was $169	**Now $129**	Save $40
Cat. MP-3118	**13.8VDC 240 Watts**	Was $269	**Now $219**	Save $50

See Cat. page 148 for full details on all models:

45W Industrial DIN Rail Switchmode Power Supplies

Check out our fantastic new low prices. Compact and lightweight, they feature temperature, voltage and current protection. Built-in EMI filter and power on LED. Input voltage from 85-264VAC. 1 Year Warranty. See Cat Pg 147 for Specs.

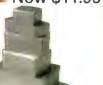
12VDC 3.5A
Was $129.95 Save $40.95

Cat. MP-3190 $89

24VDC 2.0A
Was $129.95 Save $40.95

Cat. MP-3192 $89

IEC EMI 6A Power Line Filter



Meets International Standard Leakage Requirements. Rated at 115/250VAC up to 6A.

Was $13.95 Save $2

Cat. MS-4003 Now $11.95

Save 10% on Sealed Die-Cast Aluminium Boxes

Cat. HB-5030	**64 x 58 x 35mm**	**Was $8.90**	**Now $8.01**	**Save $0.89**
Cat. HB-5036	**115 x 65 x 30mm**	**Was $13.50**	**Now $12.15**	**Save $1.35**
Cat. HB-5040	**115 x 65 x 55mm**	**Was $16.00**	**Now $14.40**	**Save $1.60**
Cat. HB-5042	**115 x 90 x 55mm**	**Was $17.50**	**Now $15.75**	**Save $1.75**
Cat. HB-5046	**171 x 121 x 55mm**	**Was $34.95**	**Now $31.45**	**Save $3.50**
Cat. HB-5050	**222 x 146 x 55mm**	**Was $36.95**	**Now $33.25**	**Save $3.70**

6 Way Mains Board with Mains Filter

Provides surge and spike protection for mains appliances.

Was $34.95 Save $10

Cat. MS-4031 $24.95

4 Way Heavy Duty Terminal Strip

These Klippon brand terminals are German made, rated at a huge 20A/250VAC. Feature screw type connections. Size 56x26x18mm. Was $2.95 Save $0.95ea

Cat. HM-3180 Now 5 for $10

Stock Up and SAVE!

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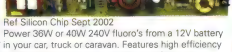

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If you do a lot of multi-conductor cable wiring or cable troubleshooting, you'll find this project especially handy. It consists of two very compact units: a signal injector which produces a very distinctive 'warbling whistle', and a sensitive signal tracer which can help you easily identify the cable conductor(s) carrying the warbling test signal. The signal tracer unit can easily be adapted for other kinds of signal tracing as well.

'WHISTLE & POINT' CABLE TRACER

By Jim Rowe

It should be easy but it's often a pain. Most multi-conductor cables are colour coded, so it should be a snack to connect each one to the appropriate pins of an RJ45 wall socket or whatever.

But some of the colours are often a bit hard to distinguish — especially in poor lighting, when you're crouched down behind a desk or in some other awkward location.

It is surprisingly easy to mistake the blue-and-white for the green-and-white, or the white-and-orange for the white-and-brown. And then you find that somebody's PC doesn't seem to want to talk to the network server, because you've swapped some of the pair returns. . .

Or you might be running a length of six-pair telephone cable and need to make sure that you get the pairs properly matched at each end. It can be trickier than you'd expect.

What you need in your toolbox is a compact little signal injector gizmo to squirt an easy-to-identify test signal along the conductors from one end, plus an equally compact little 'sniffer' or signal tracer gizmo so you can make sure which conductor is carrying the test signal at the other end.

These two handy little gizmos are exactly what you get when you build this project, which we've dubbed the 'Whistle & Point' Cable Tracer. (Get it? One device produces the 'whistle' to draw attention to the wire you want,

and the other then 'points' you to it...)

We can't take the credit for designing the gizmos themselves, because they were dreamed up by the team at Oatley Electronics — who are selling kits for the two PC board assemblies inside 'em.

However when they showed them to us, we were so impressed that we decided to work out how to house them in low-cost cases. This turned them into rugged little devices capable of being carried around in the usual toolbox and used reliably 'on the job'.

We also dreamed up that weird name for the project too, so it would get your attention. (So blame us for that, not Oatley!) You'll be able to buy both PCB kits from Oatley for only $24 plus post and packing (typically $7.00 within Australia).

We've calculated that you'll only have to spend an extra $16 or so at most, to fit both boards into the more expensive of the boxes we've used with on-off slider switches and batteries.

So the total cost for the complete project as a cable tracer set should still be no more than $32, buying everything from scratch. Not bad for such a handy pair of tools, wouldn't you agree?

By the way if you want to turn the signal tracer unit into a more general-purpose unit, this mainly involves using a larger speaker and building it into a larger box.

And Oatley Electronics can even help you out there, too: as you'll find in the 'Wheredyageddit?' box, for only $2.00 more they can supply husky little 50mm speakers complete with a larger plastic case which can be used to house the complete tracer. The box even contains an optional power amp IC which can be used to get more 'grunt'.

How they work

Let's look first at the signal injector unit. The circuit for this is shown in the upper part of the schematic diagram and, as you can see, it's based on a couple of very low cost 555 timer ICs, plus a C8050 NPN transistor.

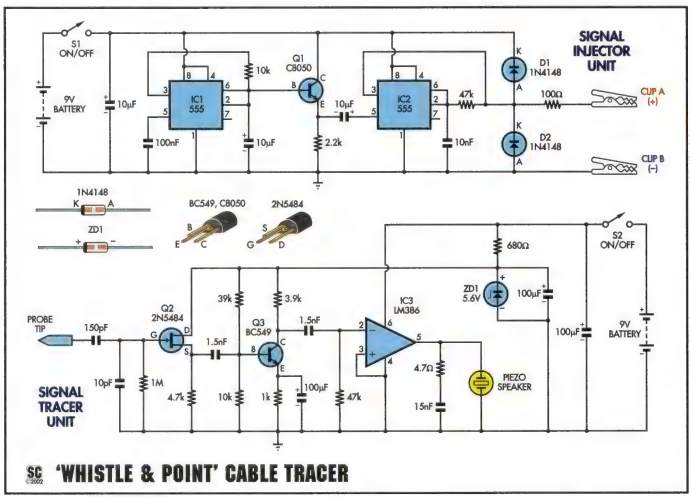
The first 555 (IC1) is connected as a simple relaxation oscillator, with its frequency of oscillation set by the 10kΩ feedback resistor from pin 3 to pins 2 and 6, and the 10µF capacitor from pins 2 and 6 to ground.

With these values IC1 oscillates quite slowly at around 6Hz, producing a square wave at pin 3 and a 'rounded sawtooth' waveform at pins 2 and 6. It's the rounded sawtooth that we make use of, but since pins 2 and 6 are operating at a fairly high impedance, we use transistor Q1 as an impedance matching emitter follower.

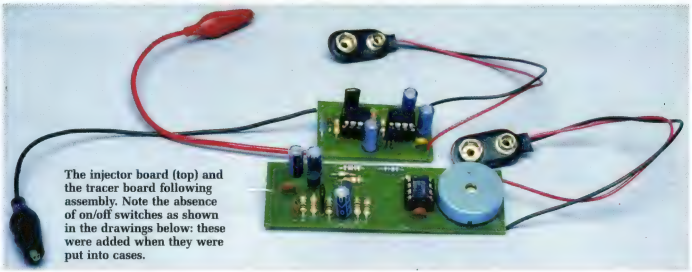
This allows us to extract the sawtooth without loading down the oscillator and disturbing its operation.

As you can see, the low impedance version of the sawtooth which appears at the emitter of Q1 is then coupled to pin 5 of the second 555, IC2. This is the 'control voltage' input of the 555, so as a result the sawtooth from IC1 is able to modulate the operation of IC2.

IC2 is again connected as simple relaxation oscillator, just like IC1.



SC ©2002 **'WHISTLE & POINT' CABLE TRACER**



The injector board (top) and the tracer board following assembly. Note the absence of on/off switches as shown in the drawings below: these were added when they were put into cases.

However in this case the main timing components are the 47kΩ feedback resistor and the 10nF capacitor from pins 2 and 6 to ground.

This gives a basic oscillation frequency of around 1400Hz but because of the modulation from IC1 the actual frequency of IC2 varies up and down between about 1150Hz and 1700Hz.

This time we use the square wave output from IC2, available at pin 3. This provides a waveform of almost 9V peak to peak, which becomes the injector's 'warbling whistle' output signal.

It's fed to the active output clip (clip A) via the series 100Ω resistor — to protect IC2 from damage due to accidental short circuits. 'Catcher' diodes D1 and D2 are also connected so that pins 3, 2 and 6 of IC2 are protected against overvoltage damage if the test clips should be accidentally connected to supply rails with voltages above or below the 9V battery rails.

So that's the injector unit. A simple, low cost circuit which generates a strong and very easy-to-recognise audio test signal, from a standard 9V battery.

Now let's look at the matching signal tracer unit.

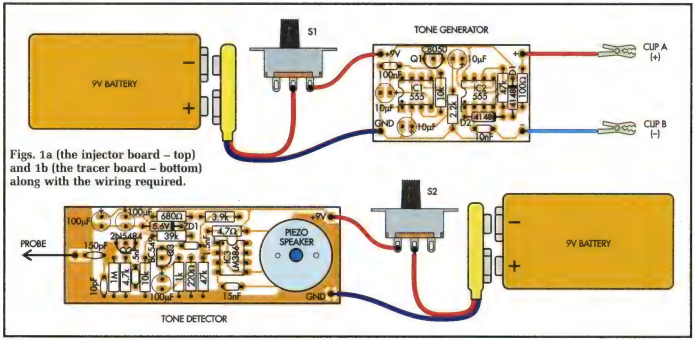
As you might expect this is basically just a fairly high gain audio amplifier, although it does have a few special aspects because of its being customised for this application.

For example because we're really only interested in tracing the injector unit's warbling whistle signal, the amplifier's frequency response is tailored to mainly respond to frequencies between 1100 and 1700Hz. This also allows us to use a very small piezo-electric speaker mounted directly on the board, as we're not interested in reproducing frequencies below 1100Hz.

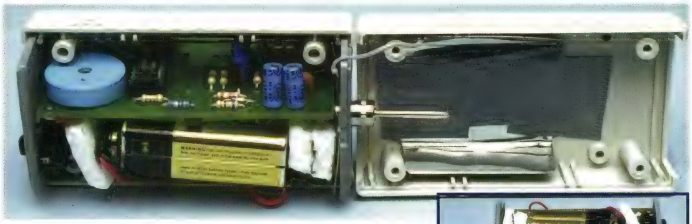
At the heart of the amplifier is IC3, an LM386 audio output device. This provides the drive for the piezo speaker, as you can see, with the 4.7Ω resistor and 15nF connected across the output as a 'Zobel network' to ensure stability.

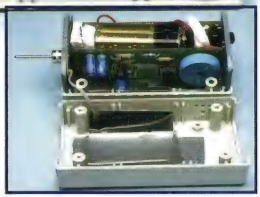
As the LM386 has a fixed voltage gain of 20 in this configuration, transistor Q3 is used ahead of it to provide additional gain and make the tracer suitably sensitive. Q3 is a BC549, used in a standard common emitter stage.

The emitter is fully bypassed to give a high voltage gain, while the use of 1.5nF coupling capacitors deliberately limits the low frequency response.



Figs. 1a (the injector board – top) and 1b (the tracer board – bottom) along with the wiring required.





Two different views of the "opened out" tracer case showing how everything is "shoe-horned" in. It's a tight fit but it will all go in! Note the probe, the tinplate shields, the insulating tape and also the polystyrene packing around the battery. All these are explained in the text.

Q3 and IC3 together would probably serve quite well alone as a cable tracer, providing plenty of gain plus a reasonably low input impedance (about 5kΩ).

However, a JFET source follower stage has been added at the input, to give the tracer a much higher input impedance (nearer 1MΩ). This will make the unit also very suitable for signal tracing in low-frequency electronic circuits, where its high input impedance won't cause unnecessary loading.

(When using it for signal tracing in such circuits, you could use either the injector unit to provide a suitable signal for tracing, or a standard audio generator set to produce a tone of about 1200-1400Hz.)

The input stage uses a 2N5484 N-channel JFET, with the signal from the tracer's probe tip coupled to its gate via a 150pF capacitor. The 1MΩ resistor provides the gate's bias return, while the 10pF capacitor shunts away any RF that may also be picked up by the probe tip.

Both Q2 and Q3 are powered from a regulated 5.6V supply rail, which is derived from the 9V battery via a simple regulator circuit using the 680Ω resistor and zener diode ZD1. The LM386 chip runs directly from the 9V battery rail but both supply rails have 100μF reservoir capacitors to ensure low frequency stability.

Construction

Apart from the 9V batteries and on-off switches, virtually all of the circuitry for both the injector and the tracer units is fitted on two very small PC boards.

The board for the injector unit measures only 41 x 25mm and has the Oatley code K181A, while the board for the tracer measures 72 x 25mm and is coded K181.

Despite the small size of both boards, fitting the components should be very straightforward as there's not all that many of them in either case.

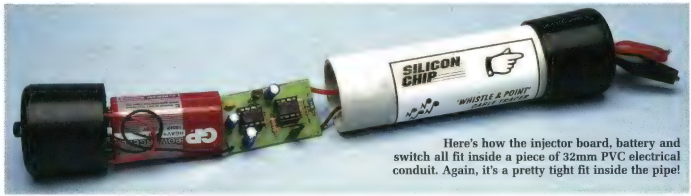
The location and orientation of each part is also shown clearly in the board overlay and wiring diagram, so if you follow this carefully you shouldn't have any problems.

As usual it will be easier if you fit the low profile components (resistors and diodes) first, then follow with the smaller and larger capacitors, and finally the transistors, ICs and the piezo speaker.

Just make sure you fit each polarised component in the correct way around, to prevent problems later. When it comes to housing each board in a protective case, you have a range of choices.

The injector unit in particular can go in virtually any small case, as long as there's room for the board assembly itself, on-off switch S1 and the 9V battery and its snap lead. The two output leads are simply taken out through a grommetted hole and fitted with small shrouded alligator clips.

To illustrate at least one of the packaging options for the injector, we



Here's how the injector board, battery and switch all fit inside a piece of 32mm PVC electrical conduit. Again, it's a pretty tight fit inside the pipe!

housed the prototype unit in a 120mm length of 32mm outside diameter PVC conduit fitted with push-on plastic end caps. This length was plenty to fit both the board and battery end-to-end, with the on-off switch mounted in one end cap and the output leads emerging through a grommetted hole in the other end cap.

This makes a practical and quite rugged little package, which can also be easily opened when you need to replace the battery. There are fewer options for packaging the tracer unit, because we found that its PC board really needs to have a certain amount of shielding.

This means that a very small metal case would be quite OK, although there aren't too many suitably sized and proportioned metal cases available — especially at a reasonable price.

You might have to make one up yourself, or modify an existing metal utility box. Of course you can always use a low cost plastic case which lends itself to fitting some shielding inside.

This can be quite practical, as we've tried to show with our housing of the prototype tracer unit shown in the photos. The case we've used is a modular ABS unit measuring 90x50x32mm, and sold by Dick Smith Electronics (Cat. No. H-2832).

As you can see from the photos this has just enough room to fit the PC board assembly and battery on-edge and side by side, with the on-off switch S2 mounted in the rear panel (offset to the side so it allows space for the PC board) and the probe tip mounted in the centre of the front panel.

As for the probe tip itself, we gave this a bit of thought and ended up buying one of the low-cost 'solderless' test probes sold by DSE (Cat. No. P-1755). It proved to be quite easy to remove the metal probe tip from the plastic body — they simply pull apart.

Then we used a small jeweller's hacksaw to cut off all but about 3mm of the larger-diameter rear section of the metal tip, leaving the remaining section as a short 'bolt head' to go behind the plastic case front panel.

The details of this should be clear from the small diagram. We drilled the front panel so that the threaded section of the tip could be passed through it, and the round knurled 'nut' (used originally to fasten the test probe lead's conductor) could then be used to fasten the tip to the front panel.

The tracer's own input wire was cut

Parts List – Whistle & Point Cable Tracer

INJECTOR UNIT

1 PC board, code K181A, 25 x 41mm
1 Plastic case 90 x 50 x 32mm, **or** 120mm length of 32mm PVC conduit plus end caps (see text)
1 Miniature slider switch, SPST (S1)
1 9V battery, 216 type
1 Snap lead for 9V battery
2 Small alligator clips, red and black
1 Rubber grommet, 10mm hole diameter

Semiconductors

2 LM555 timers (IC1,IC2)
1 C8050 NPN transistor (Q1)
2 1N4148 silicon diode (D1,D2)

Capacitors

3 10µF PCB electrolytic
1 100nF (0.1µF) metallised polyester
1 10nF (.01µF) metallised polyester

Resistors (0.25W 1%)

1 47kΩ 1 10kΩ 1 2.2kΩ
1 100Ω

TRACER UNIT

1 PC board, code K181, 72 x 25mm
1 Plastic case 90 x 50 x 32mm, **or** 150mm length of 32mm PVC conduit plus end caps (see text)
1 Miniature slider switch, SPST (S2)
1 9V battery, 216 type
1 Snap lead for 9V battery
1 Test probe (see text)
1 Piezo speaker, 19mm diameter

Semiconductors

1 LM386 amplifier (IC3)
1 BC549 NPN transistor (Q1)
1 2N5484 N-channel JFET (Q2)
1 5.6V 400mW zener diode (ZD1)

Capacitors

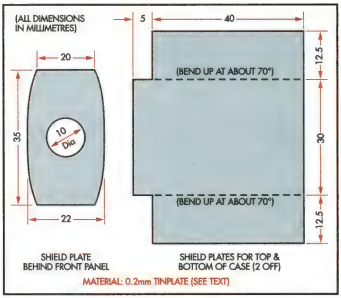
3 100µF 10VW PCB electrolytic
1 15nF (.015µF) metallised polyester
2 1.5nF (.0015µF) metallised polyester
1 150pF ceramic
1 10pF ceramic

Resistors (0.25W 1%)

1 1MΩ 1 47kΩ 1 39kΩ
1 10kΩ 1 4.7kΩ 1 3.9kΩ
1 1kΩ 1 680Ω 1 220Ω
1 4.7Ω

Resistor Colour Codes

	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	1	1MΩ	brown black green brown	brown black black yellow brown
❑	1	47kΩ	yellow violet orange brown	yellow violet black red brown
❑	1	39kΩ	orange white orange brown	orange whitebiack red brown
❑	5	10kΩ	brown black orange brown	brown black black red brown
❑	2	4.7kΩ	yellow violet red brown	yellow violet black brown brown
❑	2	3.9kΩ	orange white red brown	orange white black brown brown
❑	2	2.2kΩ	red red red brown	red red black brown brown
❑	2	1kΩ	brown black red brown	brown black black brown brown
❑	2	680Ω	blue grey brown brown	blue grey black black brown
❑	2	220Ω	red red brown brown	red red black black brown
❑	1	100Ω	brown black brown brown	brown black black black brown
❑	1	4.7Ω	yellow violet gold brown	yellow violet black silver brown



We found that a shield was necessary inside the plastic case to prevent the high-gain amplifier picking up too much RF energy. Ours came from an empty pineapple tin – if you don't like pineapple eat something else.

Panel labels for the injector unit (above) and tracer unit (below). As there are no on-panel controls, placement is nto critical.

very short and soldered directly to the rear of the probe tip, behind the panel. It all worked out quite neatly.

To provide the shielding, we cut three small shield plates out of a strip of 0.2mm tinplate salvaged from a small tin which until recently contained pineapple pieces(!).

The shield plates were shaped as shown in the small diagram, with the barrel-shaped piece designed to go behind the front panel (its 10mm hole clearing the rear of the probe tip) and the two more rectangular pieces designed to go into the front sections of the top and bottom halves of the case itself.

These latter pieces have a 12.5mm deep section on each side bent upwards at about 70°, so their centre sections lie flat inside each half of the case yet their shielding extends around the sides.

When the shield plates had been cut out and any sharp burrs removed, we then fastened them to the rear of the front panel and inside the case halves. We used small pieces of gaffer tape for this, but you might prefer to use a few dobs of epoxy cement (like 5-minute Araldite).

Then we soldered some short lengths of insulated hookup wire to connect all three shields together, with another short length so they could be connected to the PC board's earth line when it was placed in position. (They have to be connected to the board earth, to provide correct shielding.)

Before mounting the PC board in the case, we applied a small strip of gaffer tape down the centre of each case-half shield plate, to make sure that the plates couldn't cause any short circuits at the edges of the board.

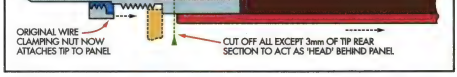
By the way, it's OK to use Gaffer Tape as insulation for low voltage devices like this but only properly rated electrical tape should be used on higher voltages.

As well as cutting holes in the front and rear panels to take the probe tip and on-off switch, we also drilled some small (2mm diameter) holes in one side of each case half near the rear end, to allow you to hear the sound from the piezo speaker when the case is screwed together. You can hopefully see these holes in the photo.

When the board assembly was fitted in the bottom half of the case, the front panel with probe tip mounted on it was slotted in too and the board input wire carefully bent around to go into the hole in the rear of the probe tip.

Then the two were soldered together quickly, so as not to overheat either. The rear panel with switch S2 fitted was slotted in at the other end, and the wires from the PC board and battery clip lead soldered to the contacts of S2.

After this the wire from the shield plates was carefully soldered to the earthy copper at the front end of the PC board. Then the battery was added and squeezed in alongside the PC board (on the copper side), with a



Here's how we turned a multimeter probe into our tracer probe while at right is a close-up photo showing how it mounts to the tracer case.

Capacitor Codes

Value	Alt. Value	IEC Code	EIA Code
100nF	0.1uF	100n	104
15nF	.015uF	15n	153
10nF	.01uF	10n	103
1.5nF	.0015uF	1n5	152
150pF	–	150p	150
10pF	–	10p	10

small piece of plastic material between the two to prevent shorts.

Some small pieces of expanded polystyrene were added as 'packing pieces' at either end of the battery, to prevent it moving forward or backward and causing trouble.

Finally the top half of the case was fitted, taking care to dress the battery leads so they weren't squashed between the case halves.

Using them

Checking cables using the two devices is quite straightforward. All you need to do is connect injector output clip A to one end of the wire you're trying to trace, and connect clip B to either another wire, or a number of other wires, or some earthy metalwork.

Then you turn both units on, and start probing the far end of all of the wires with the tracer unit. When you contact the right wire with the probe tip, you'll hear the injector's 'warbling whistle' quite clearly.

Note that you don't really need an earth return wire for the tracer, because the tracer amplifier is very sensitive and there's enough capacitance between the shield plates and your hand to provide a high impedance return path.

Of course if you want to use the tracer to check signal paths in equipment PC boards, then you will have to fit it with an earth-return input lead.

This could consist of a 500mm length of insulated hookup wire, with one end soldered to the earthy copper at the front of the tracer board, and the wire brought out of the case through a 1.5mm hole drilled in the side.

The far end of the wire would be fitted with a shrouded alligator clip like those on the injector output leads.

You'll only need to add this lead to your tracer if you do want to use it for general signal tracing work on PC boards, though. For cable tracing, it's not needed. **SC**

Wheredyageddit?

This project and the PC boards are copyright Oatley Electronics.

Oatley have available a kit (K181) with both PC boards and on-board components plus the 9V battery snap leads and the piezo speaker for $24.00 plus $7.00 for packing and postage if applicable. This does not include the on-off slider switches, plastic cases, batteries or probe tip as described in the text.

However Oatley can supply a larger 'surplus' plastic case with a PC board containing a husky 50mm speaker and an optional audio power amplifier — all very suitable for 'beefing up' the signal tracer unit — for an additional $2.00.

Oatley Electronics can be contacted by: phone (02) 9584 3563; fax (02) 9584 3561; mail to PO Box 89, Oatley NSW 2223; email (sales@oatleyelectronics.com); or via their website (www.oatleyelectronics.com).

Book Review . . . by Leo Simpson

Firsts in High Fidelity. The Products and History of H. J. Leak & Co, by Stephen Spicer. 1st edition published 2000 by Audio Amateur Press, USA. Soft covers, 195 x 260mm, 272 pages. ISBN 1-882580-31-1

Anyone who is over 45 probably is aware of the legendary English hifi company, H. J. Leak & Co Ltd, although unless you were reasonably well-heeled in the years preceding 1970, it is unlikely that you would have ever owned their products. I certainly knew of their products in those years but they were priced way above my means. So were the products of other notable English companies such as Quad, A. R. Sugden and Wharfedale. It was more a matter of admiring them from afar.

So it is with considerable interest that I received this sample copy about the products of the Leak company. They made a range of amplifiers, tuners and loudspeakers and all were notable in some respect or other apart from high performance, for the day.

Of particular interest was the Leak sandwich loudspeaker, based on a 13-inch woofer with a "sandwich" cone consisting of a core of expanded polystyrene foam sandwiched between aluminium skins. This very rigid cone was shown in adverts (in Radio TV & Hobbies) supporting the full weight of the founder, Harold Leak.

One of the reasons why Leak amplifiers were so highly regarded was the quality of construction. Not only was the underchassis layout beautifully symmetrical but the transformers were extremely well made, with diecast covers. They were very good performers too, with plenty of negative feedback (a supposed anathema to today's valve amplifier enthusiasts) and harmonic distortion of less than 0.1%.

For me though, there was a certain English eccentricity about some Leak products and none more so than the "trough-line" FM tuner. I had always assumed that this was another English oddity but it turns out that the "trough line" was quite innovative in its day and used a tubular transmission line in place of the conventional coil inductor used in the local oscillator. This method of construction gave very good frequency stability. Nowadays, AFC (automatic frequency control) largely achieves the same result.

Another interesting chapter in the book is devoted to the Australian manufacture of Leak loudspeakers. This was started by Syd McClory, a well-known personality on the local Sydney hifi scene at the time.

All told, these book is a wonderful source of information on Leak products, whether you just want to engage in nostalgia or whether you are involved in restoring or building a Leak amplifier. To that end, there are quite a few circuit diagrams for amplifiers and tuners.

The book is priced at $59.95 plus $8 postage and packing. It is available from Evatco, PO Box 487, Drysdale, Vic 3222. Phone (03) 5257 2297. email evatco@mira.net

SERVICEMAN'S LOG

Big TV sets can be a nightmare

Big sets which cost an arm and a leg when new can present real problems when they finally fail, ten years down the track. I got caught this month with a Sony set which cost over $5000. I should have known better...

Things have changed a lot since I first took up servicing, even going back to the monochrome days but, particularly, since the advent of colour. I often used to hear, "My set is 25 years old, it has never been repaired and it is still going perfectly"

Well, frankly, I have yet to see a perfect 25 year old TV set that has never been fixed, but I am seeing a lot more 10-year old TV sets that have never had their backs off. To my mind, that is a fantastic salute to the manufacturers.

On the other hand, I have had several 1989 Mitsubishi TV sets recently with intermittent total or partial vertical collapse and the only fault has been faulty joints. The picture tubes were still in excellent condition.

There was a time when the only choice in acquiring a TV set was the size of the picture tube and design of the cabinet. Nowadays the list of options is enormous and many features are incorporated whether one uses them or not.

My own kids have never known monochrome TV and probably would not even know how to operate any old set without a remote control. It's hard to find a TV set today without AV inputs, while turret tuners and even pushbutton tuning systems have long gone the way of the dodo.

So, what to do with a top-of-the-range TV set that is ten years old and cost over $5000 new? If some of the deluxe features fail, one can probably live without them but most times it is a general failure. So, should the set be abandoned, knowing that for a third of the original price, it can be replaced it with one having many more features?

It is most likely that the total waste of the excellent technology which that cost heaps of money, which more or less impels the owner to get it fixed.

So it was with a 1992 Sony Kirara Basso that was delivered (fortunately) to the workshop.

The 34in/80cm set weighs 81kg and even the 29in/68cm version weighs 56kg – apparently due in part to the heavy iron support frames used in the Trinitron tube set-up.

I have written before on this series, using the G1 chassis. This particular model was an overseas version – KV-

SNUPPIT
FROOM
WHOOMF
FOOP!
BANG!
SPROING
SPROING
SPROING

S29MN1 (SCC-F51B-A) – and the fault description was "dead".

When this set decides to spit the dummy on the power supply board, the result can be spectacular, not to mention expensive. When the pyrotechnics finish, it is best to replace all the following 16 parts: Q601, Q602, IC601, D626, D603, D604, D605, D606, VDR601, R606, R625, R626, C616, C618, C617 and C619. (Q601 and Q602 should be replaced with 2SC4834NS.) And if genuine Sony parts are used, the trade price is over $300!

Why does it blow? Apparently because four (blue) capacitors become leaky. In my case, these repairs were straightforward but when the set was switched on, all I had was a white line across the screen and no sound. Also, there was no AV in or out.

On the D board I replaced the vertical output IC503 with an STV9379 and electrolytic C570 with a 220µF 25V, the latter mounted on the PC board track side, between IC503 pin 4 (-) and chassis (+). This made no difference and I then replaced Q1801 and Q1802 on the VC board, plus C1802.

Others should be warned that there are two different versions of the VC board in this series, which are not interchangeable. I also changed all the electros on this module but still wasn't getting anywhere.

Despite this set having very short leads (the eight extension leads cost an average $32 each), the main chassis can be balanced, very precariously, on its side, to get limited access to the motherboard's tracks.

With the multimeter I confirmed that all the voltage supplies were correct; there are dozens to be checked.

Next, I concentrated on the jungle IC, IC3501 CXA-1464AS, on the A board. Despite having the correct voltages going in, there was no vertical output on pin 31. The oscillator was working on pins 32, 33 and 34 but absolutely no output drive. Reluctantly I ordered and replaced yet another expensive 40-pin high density IC but to my horror I found there was still no vertical output.

By now I had exceeded the estimate I had given the client and had to get back to him and report on my progress. Suffice to say he wasn't impressed, nor was he prepared to continue and said I could keep the rotten set.

This wasn't the best news I could have had; I now owned an expensive lemon, wasn't sure how to proceed and what to do to recover the costs and effort already invested. I put it aside until such time as there was a lull and also give me time to collect my thoughts.

Months later, I re-measured every pin on the 48-pin jungle IC and checked it off against the circuit. Everything was correct except for one pin. Pin 48, the SDA or Data Line, of the I2C digital control, was low at 0.64V instead of 5.6V. At last I had a clue that might possibly lead me somewhere. But this 5V line goes all over the set, to almost every IC.

It took an awful long time to discover where this voltage disappeared, by the very lengthy process of unsoldering each and every component on the rail until the 5V was restored.

This set has two I^2C lines, one for the tuners and front end and the other for the rest of the set. It comes out of the microprocessor M module on CN1108 pin 31 from the two EEPROMS and pin 22 of IC005.

Logically, I started at the jungle IC, IC3501, and unsoldered pin 48 but it involved a very long time via very diverse routes. I won't go into how much time was wasted following just one red herring; the V-PROTECT line, which was (for obvious reasons now) giving incorrect voltages.

But I finally arrived at pin 14 of IC3503, CXA1315P, which was loading the 5V line. Of course, once I had found the culprit everything fell neatly into place. Pin 5 of this IC connects via CN1132 pin 10 (H-TRAPZ) to CN501 D Board and from there to pin 7 CN502/CN1801 pin 5 via R1816 27k, which all has to do with east/west and north/south correction.

Replacing IC3503 finally fixed all the problems at one go. My challenge now is to sell the set and recover my costs – but I must say it does perform very well and the twin tuner picture-in-picture is a treat.

Subsequently, I have had a few more of this model with miscellaneous faults. One had intermittent AV inputs which was due to faulty joints on the hinged connector between J and B boards CN2301/CN308 and CN2302/CN309.

Another set had total or intermittent no-sync. I checked PS01, 0.6A fuse, on the Teletext module V which supplies 5V to the text processor, IC02. Then I re-soldered several faulty joints on IC208 and IC209, 9V and 5V IC regulators, on A1 Board. From here I eventually found that the problem was IC502, the SBX1692-01 Digital Comb Filter on board B1. The main problem for that was the cost – $241.93 trade, plus freight.

Philips Anubis

My next story concerns the Philips Anubis type chassis. This chassis covers hundreds of models of TV sets and has spawned a large number of variations; eg, "Anubis A" to "Anubis S" and then "Anubis S AA" to "Anubis S DD". These are the ones I know about and I'm sure that other technicians could nominate more.

In my case, the service manuals for this one chassis occupy nearly one filing cabinet drawer. It also makes it very difficult to match the exact circuit with the set model, as the Philips Product Survey only shows "Anubis A", "B", and "S", etc and not the letters after that.

Against this background, here is a story about one of these sets. It was a 1997 Singapore-built Philips 21PT128A/75R with an "Anubis S DD" chassis. My customer, a Mrs Blossom, had brought this set in from a northern beaches suburb, so it was a little rusty. And although the fault ticket read "dead", it was actually pulsating very quietly.

I shorted out the base and emitter of the horizontal output transistor (7445), a BU1598CX, and then hung a 100W globe across the collector to emitter. Switching on lit the globe and the HT settled at 95V. Well, at least the power supply was good but it also suggested that the horizontal output transformer (5445) probably wasn't.

Hoping that was all, I ordered a new one. Unfortunately, because of all the variants, it is important to order the correct part number, which in this case was 4822 140 10557. And, as luck would have it, it is directly equivalent to the Spanish-made

Items Covered This Month

- APPLE m3502 21-inch monitor
- PHILIPS 21PT128a/75R TV
- PHILIPS KR6687T TV set
- SONY KV-S29MN1 80cm TV

DIEMEN HR7815 transformer.

(Note: the 4822 140 10486 is no longer available for the 50cm Anubis S BB and 35cm CC and the HR7815 has to be modified to fit. As well, C2450 has to be changed to 680nF 250V.)

When the new transformer arrived and had been fitted, I was disappointed to find that the set still had the same problem. I then found that the horizontal output transistor (7440, BF422) was short circuit but replacing this still made no difference.

Using an oscilloscope, I found that in fact there was little or no output from pin 37 of the jungle IC (IC7225). A TDA8362 replacement for TDA8361 finally restored the EHT and produced an intense white raster. A few measurements then showed that resistor R3300 (10Ω), which feeds 160V to the video output stage, was open circuit. Finally, after a few adjustments I had a good clear picture.

I don't know how this sequence of events happened but I certainly felt unlucky to encounter so many faults in this set. Still, the end result was quite satisfactory.

Mr Ellis's Philips

I have repaired many Philips 2B-S chassis TV sets over the years but now feel that they really are getting too old. However, when it is quiet, I still occasionally take on a repair for this series, even though it is against my better judgement.

Recently, I foolishly took one on at a Mr Ellis's house. He had a 1987 28CT8893/75T or KR6687T and he was complaining about a "kink" in the picture, about two thirds up the screen. I figured that it had to be easy and was probably C2571 (100µF 63V), which does give trouble.

When I arrived, I removed the back and turned the set upside down. This way I get a manageable access to the PC board. I pulled the chassis out far enough to work on it and replaced the capacitor. I also spent a long time resoldering the entire chassis.

An hour later, my cockiness had been completely knocked out of me. I still had the same fault even after changing the IC and all the nearby electros. I measured the HT to be spot on at 140V and I also measured all the voltages around IC7570. The only significant one out was pin 8, which the service manual has at 14V but which I read as 19.6V.

It's quite amazing, really, how one can work on these sets for 15 years and yet never notice some of the changes that have been made to the model over its life. In this case, the 26V or 27V supply rail from pin 4 of the horizontal output transformer had been changed. Diode D664, resistors R3647 & R3646 and fuse F1646 had all been changed from the circuit diagram – the diode had another strapped in parallel, R3647 had been deleted and R3646 reduced from 2.7Ω to 1.5Ω. The fuse was now an 800mA button type.

I checked all these and they were all OK. After a lot of mucking about, I found that by shorting L5646, R3648 and R3646, the symptom would disappear completely and the supply voltage would increase by 0.4V. Interestingly, this also made IC7570's pin 8 voltage rise to 20V.

Well, I searched my soul but I couldn't see why such a small increase could fix this symptom. And as there were no signs of stress anywhere, I decided that I would allow this "bodgie fix" to remain. After all, the set is now 15 years old and is already well past its use-by date. But at least Mr Ellis would get a little more life out of it.

I returned the set to Mr Ellis, made a nominal charge and warned him that he was probably working on borrowed time. I think he understood.

She's apples

Some years ago, while reading the classified ads, I spotted a 21-inch Apple computer monitor for sale for just $50.00. Although unsure of the connections or resolutions that Apple computers worked on, I thought it was worth the risk as a potential standard PC monitor or at worst, a video monitor.

Unfortunately, when I arrived to inspect it, I discovered that I would not

be able to see it working – there was no computer or even a lead to connect it to the computer. The only sign of life was the green power LED on the front panel.

However, I did discover that the deflection and EHT sections were probably OK, by observing the collapsing raster when it was turned off (any problem here would have made it too expensive to repair).

In the end, I bought it for just $40.00 (I haggled). It was worth a gamble – the cheapest 21-inch monitor at that time cost over $2000.00.

On the way home, I called into a couple of local Apple agents to try to get a video lead, as this monitor only had a 'Sun' socket. The first agent I called into specialised in secondhand as well as new Apple and PC hardware. He could only locate a secondhand cable with a 'Sun' connector to individual BNC connectors, which meant that it would have to be modified (ie, by fitting a VGA connector in place of the BNC connectors). I wasn't very keen on paying the $40.00 that he wanted for this secondhand lead but he challenged me to do better and refused to negotiate, so I left empty-handed.

The second agents sold just new Apple equipment but said they could obtain an original secondhand lead from a customer for only $200.00! Hiding my shock and regret for not getting the first lead (I couldn't possibly go grovelling back to the first shop), I calmly asked about obtaining a circuit diagram for the monitor but was told that this was not available.

By the way, I have since discovered that WES Components (Phone 02 9797 9866) now sell 'Sun' type leads and adaptors for just $24.50 (now that I don't need one). However, they still have to be modified as Apple didn't use the standard configuration.

Fig.1: signal input connector as seen from the rear of the monitor

Fig.2: standard 15-pin VGA connector.

Arriving home, I hit the Internet in search of as much information I could find about the Apple M3502 21-inch monitor. It turns out that the 'Sun' connector is also known as a 13W3 video connector – see Fig.1.

Apple's 13W3 standard differed from the normal, swapping the red and blue. However, as there doesn't appear to be any standard for the sync connectors, Apple's configuration is as good as any.

The pins of interest are A1-blue, A2-green, A3-red, 2-Vsync and 6 - Hsync. I decided to hard-wire an old VGA lead from a wrecked monitor to the back of this socket. Fortunately, there is enough room between the circuit board that carries this socket and the one behind it to drill a hole large enough to take the VGA cable's original mount (I had to nibble out a square hole).

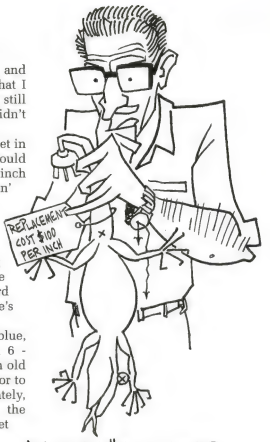
The other end of the video lead is the standard VGA connector on the lead and did not have to be modified. Its pin attachments are as shown below.

Signal Type : Analog	
1 - Red	9 - No Pin
2 - Green	10 - Ground
3 - Blue	11 - ID Bit
4 - ID Bit	12 - ID Bit
5 - Self Test	13 - Horiz Sync
6 - Red Return	14 - Vert Sync
7 - Green Return	15 - ID Bit
8 - Blue Return	

The pins of interest are 1-red, 2-green, 3-blue, 13-Hsync and 14-Vsync. The earth pins are left as is.

The next step was to set up the computer. Hooking the monitor up to the computer did produce a picture but with no vertical or horizontal sync and only half height. It was time to hit the Internet again.

This time I discovered that the Apple M3502 monitor has a fixed resolution of 1152 x 870 pixels and a horizontal frequency of 67.5kHz. This is very close to the PC standard of 1152 x 864 pixels and 68.7kHz. The vertical refresh rate is 75Hz and the dot pitch is 0.26mm, which is pretty good even by today's standards.



Changing the computer's display resolution and scan rate to 1152 x 864 at 75Hz did lock the display in vertically (sort of) but it was still only half height and out of sync horizontally. I was able to determine, though, that there were a multitude of problems relating to the sync, blanking and linearity.

Because I had no circuit diagram and because the monitor was seven years old, I decided to replace all the electrolytic capacitors in the power supply, EHT and deflection circuits (about 50 capacitors in all). I didn't replace the main power supply reservoir electros as they all checked OK and were expensive. About half of the 50 electros replaced were way off value and this cured most of the faults except for the main ones – still no horizontal sync and a half-height picture.

Careful inspection of the picture

revealed that the vertical oscillator was running at twice the rate it should have been. I removed the small signal deflection board, checked everything but could not find any faults. As a precaution, I replaced all the electros but this had no effect.

I desperately wanted a circuit diagram but couldn't justify the money wanted by the circuit diagram sellers on the web. In the end, I carefully re-examined all the information I had acquired and discovered that instead of using standard positive-going sync pulses, this monitor required negative-going sync pulses. Fortunately, Windows lets you specify the pulse polarity and all graphics cards support either – all I needed was a suitable driver.

I downloaded and installed the driver development kit from Microsoft and started trying to create a driver for the monitor without much success. I had since discovered that the monitor could also operate at 1024 x 768 at an 85Hz refresh rate, so I incorporated this setting into the driver as well but it still refused to work.

In fact, the sync looked exactly the same on-screen as before and checking the sync pulses coming from the graphics card with an oscilloscope revealed that they were always positive-going, no matter what was specified in the driver.

I checked the spot in the Windows registry where monitor resolutions are stored and discovered that they were as they were supposed to be, according to the driver (that is negative sync for H and V). So why were the polarity settings being ignored?

In the end, I abandoned this approach after discovering various software packages that let you change the sync pulse polarity on the fly. The best package I found was a shareware program called "Power Strip" and it does a lot of other stuff as well, including keyboard shortcuts (necessary if some rogue program changes the screen resolution and you can no longer "see" the screen to change it back because it's out of sync). With this package installed, the monitor instantly locked in and I had full height – all that remained was to reset the internal presets for an optimum display (this monitor had been well twiddled by someone before I came along).

One day, while pondering the meaning of life and why the monitor driver didn't work, I happened to test an Osborne MPV 1024 NI 14-inch monitor. This worked fine at a resolution of 640 x 480 but on 800 x 600 or above, there was no sync and a half-height picture. I spent some time looking for a fault before it dawned on me that I had seen this problem before.

A search on the Internet revealed that this monitor works on positive sync pulses for 640 x 480 but uses a combination of positive and negative sync pulses for the other two resolutions.

In addition, I managed to find a driver for this monitor (created by a user, not Osborne). I changed a couple of scan rates slightly to comply with the monitor's specifications (the driver must have originally been created by trial and error) and then installed it on my computer.

As before, Windows just ignored the sync polarity settings (as per the Apple monitor). However, the "Power Strip" software permits you to specify different polarity settings for the horizontal and vertical sync pulses for each resolution and so the Osborne worked perfectly.

The Osborne monitor was about the same age as the Apple monitor and I started wondering about this. All PC monitors since about 1995 work with on positive-going sync pulses, so it appeared as though Microsoft had decided that all subsequent versions of Windows (ie, from about Windows 98 on) would just ignore the sync pulse polarity settings required by these older, daggier monitors.

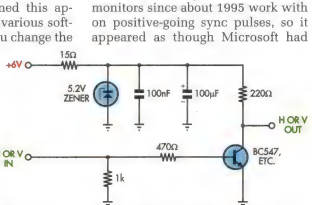


Fig. 3: two of these sync pulse inverters needed, one each for horizontal and vertical pulses.

To test this theory, I installed Windows 95 on another computer (my machine uses Windows 98), installed the Osborne driver and found that the Osborne monitor now worked perfectly on all supported resolutions. What's more, so did the Apple monitor with the driver I had created all those months ago.

After using the Apple monitor with "Power Strip" for some time, I subsequently upgraded my operating system from Windows 98 to Windows 2000. Unfortunately, my version of Power Strip (ver. 2.78) would no longer work (version 3.0 and above may work with Windows 2000 but I haven't tried it).

In the end, I modified the Apple monitor itself by installing a couple of simple sync pulse inverter circuits (see Fig.3). This simply involved cutting the horizontal and vertical lines inside the monitor (pins 6 & 2 to the sun connector) and hard-wiring the inverter circuits in series. A 6V rail to power the circuit was taken from a plug connection on the main deflection board directly above.

These hardware modifications enabled the Apple monitor to work perfectly without any special software. In Windows 98/Me, you first set the resolution to 1152 x 864, then click the Advanced button and change the refresh rate to 75Hz. Windows 2000 and Windows XP are similar except that a different refresh rate can be set for each resolution.

Note that some lesser graphics cards don't permit you to change the refresh rate. Some don't even support 1152 x 864, while those that do don't necessarily support a 75Hz refresh rate at that resolution. Those that did work OK included S3 4MB AGP, TNT2 M64 (both PCI and AGP versions) and GeForce 2 cards.

Anyway, the old Apple monitor served me faithfully for about 18 months. I then sold it and bought a nice flat 17-inch monitor that supports every resolution up to 1600 x 1200. **SC**

Honda fuel cell vehicle released in USA

The Honda FCX has become the first fuel cell vehicle in the world to receive government certification, paving the way for the commercial use of fuel cell vehicles.

Both the US Environmental Protection Agency (EPA) and the California Air Resources Board (CARB) have certified the hydrogen-powered Honda FCX as meeting all applicable standards.

The FCX has been certified by CARB as a Zero Emission Vehicle (ZEV) and by the EPA as a Tier-2 Bin 1, National Low Emission Vehicle (NLEV), the lowest national emission rating. The FCX will also meet US safety and occupant protection standards.

Honda will start a lease program for a limited number of FCXs in the USA and Japan by the end of this year. During the first two-to-three-year period, Honda will lease about 30 fuel cell vehicles in California and the Tokyo metropolitan area, two locations with access to a hydrogen fuel supply infrastructure. The company currently has no plans, however, for mass-market sales of fuel cell vehicles.

"Certification allows Honda to place fuel cell vehicles in commercial operation," said Tom Elliott, American Honda executive vice president.

"We'll have an opportunity to evaluate fuel cell vehicles in real world applications and to study the development of a refueling infrastructure to support fuel cell vehicles. However, it is important to remember that significant cost, technology and infrastructure issues remain prior to the mass marketing of fuel cell vehicles."

This latest version of Honda's fuel cell vehicle achieves 15% more drive motor torque than previous models and also provides improvements in mid-to-high range power output and acceleration. It also has an increased driving range of 355km, about 40km more than the previous model.

Honda started fuel cell research in 1989 and has been road testing vehicles in the United States and Japan since 1999. **SC**

Honda FCX specifications

Length	4165mm
Width	1760mm
Height	1645mm
Maximum Speed	150km/h
Driving Range	355km
Seating Capacity	4 adults
Motor Power Output	60kW
Motor Torque	272Nm
Motor Type	AC synchronous
Fuel Cell Stack	PEFC (proton exchange membrane – Ballard)
Fuel Cell Power Output	78kW
Power storage	Honda Ultra Capacitor
Fuel	Compressed hydrogen
Storage	157 litre high-pressure tank (5,000 psi)

ALTRONICS

overnight delivery

We aim to provide as much information as possible in our catalogue and via phone or email before you make your purchase. But in the event the product doesn't suit your needs, **don't worry!** Return it to us within 14 days and we'll give you a **FULL REFUND** (less freight costs).

Jack O'Donnell, Managing Director

Security Gear for Home & Business

Infra Red Illuminator

Fantastic for use in carports, under eaves or in any area where you need illumination for camera's at night time. With 28 IR LED's and housed in a rugged aluminium casing. 12VDC. **Was $79**

$69
S 9140

Time Lapse VCR

Record for over 53 days straight!

Records up to 1280 hours of footage on a single 4 hour tape! **Was $950**

Features: Daily or weekly event programmable recorder • Remote activation from PIR's or other detectors • Switching outputs for multiplexers or quad processors • Program memory in case of power loss • Security lock to prevent record stoppage • Remote control

$855
S 9330

4 Way AV Switcher

This versatile switcher will switch up to 4 camera inputs with audio. Each channel can be viewed sequentially and switching time can be adjusted between 1-15 seconds. Handy dual outputs allow simultaneous viewing and recording!

Features: • BNC video • RCA audio • Suitable for both B&W and colour cameras • Unused channels are isolated from viewing. • 240V Operation **Was $169**

Suits B&W or Colour cameras!

$152
S 9198

Wireless AV Sender with IR Repeater

Ideal for both security or home theatre/hi-fi use. Simply connect up an audio and video source to the transmitter and your television or security monitor up to the receiver. Or use one in the home to transmit for example a DVD from your lounge room to your bedroom and control the player with the inbuilt infra red (IR) repeater. **Was $229**

$215
S 9360

Complete Electronic Security!

A complete guide to the world of electronic security methods and surveillance. With practical ideas and solutions to keep your home or business secure. Information on CCTV, Intruder/fire alarm systems, access control and home automation is provided. **Was $79**

$69
B 2445

30W Hi-Fi Speakers

Light weight speakers that deliver an unbelievable sound for their size making them perfect for home theatre systems, or as satellite speakers for the patio, games room, small boutique or restaurant. Features: • 30W Max power • 8Ω • 2 way speaker system • Size: 110x130x130mm

$79
C 5280

Normally $99!

Telescopic Stands

Adjustable slimline powdercoated stands ideal for use in home theatre systems with satellite speakers. Adjustable from 600-1000mm. Top bracket suits speakers up to 190mm wide.

Sold in pairs. Was $75

$65
H 8070

Deluxe Headphones

Super comfortable with deep bass!

With super thin diaphragm drivers for superior sound reproduction High quality flexible lead. Features: Soft ear pads • Gold plated 3.5mm stereo plug & 6.5mm adaptor • Samarium cobalt magnets **• Was $29.95**

$25
C 9004

Nicad & NiMh Charger

$29.95
A 0288

This battery charger automatically discharges the battery prior to charging it. Thereby reducing memory effect which can reduce the overall life of your batteries.

Features: • Simple and easy to use • Charges up to 4 batteries at a time • Charge and Discharge LED Indicators • Includes automatic discharge then recharge function • 240V Operation • Suitable for AAA, AA, C, D, 9V batteries

USB-Serial Converter

Don't rush out and buy new USB equipped printers, mice, digital cameras, etc! Using this adaptor, you can turn a serial device like a printer, modem, mouse or similar into USB capable item. Save $$$ on upgrading to new equipment.

$79
D 2340

Cat 5e & 6 Data Cable

Dymo-Link Cable Cat 5e Cable

Authority approved Cat 5e & 6 cable, in a HUGE 305m pull box.

Prices are PER BOX ONLY

49c/m
Cat 5e: W 2760

98c/m
Cat 6: W 2764

Buy a box and save a fortune!

Get all these specials ONLINE!

• www.altronics.com.au •

Quality CCD CAMERAS!

CCD Colour Mini Camera with Audio

A compact mini camera with SHARP sensor and inbuilt microphone. 330 line resolution, 70° lens. **Was $219**

$199
S 9052

B&W Dome Camera with Infra Red Illumination

Ideal for low light areas where a discrete security solution is required. 420 lines. **Was $99**

$89
S 9112

B&W Dome Camera

Features high quality SAMSUNG sensor with 380 lines of resolution. Compact design, easily adjustable. **Was $109**

$98
S 9110

Integrated PIR / B&W CCD Camera with Audio

Kill two birds with one stone! Ideal low cost total surveillance solution. Can trigger recording to a VCR. 380 line resolution, 92° lens. Bracket supplied. **Was $208**

$188
S 9040

HIGH POWER CAR AUDIO

HIGH POWER HEAVY-DUTY VENTED DOUBLE MAGNETS!

Boschmann Subwoofers. Incredible performance specifications. Kevlar impregnated spruce pulp cone for efficiency and strength. Enhanced long lasting foam surround. High temperature Kapton™ voicecoil former with 4 layer winding for incredible sound reproduction and longevity. Super strong cast alloy basket with chrome plating.

$159ea or 2up $120ea
C 3049 4½ 10 Inch 500W Max.

$199ea or 2up $150ea
C 3051 4½ 12 Inch 600W Max.

Full data sheet provided

Remote Control Car Alarm

Normally $165!

This affordable alarm offers the latest in design innovation and functionality. Includes 1 point engine immobilisation, car body impact sensor, multi tone backup battery siren and flashing dash light.

$149
S 5224

Features: • 2 x remote controls with smart code learning technology • 1 point engine immobilisation • Car body impact sensor • Multi tone backup battery siren • Flashes indicators • Car finder function • Emergency panic feature • Central locking control for keyless entry • Current (voltage drop) sensing • Security override mode • Boot release via remote (where fitted) • Audible or silent arm/disarm • Flashing red dash light • 12 month warranty

130W Modified Sine Wave Inverter

The perfect sized inverter for people just wanting to run a laptop in a remote area for an extended period of time. Dont get caught with no power when you need it most! 12V 130W. **Was $119**

$99
M 8102

BONUS OFFER! Buy an M 8102 this month and we'll give you this P 9650 Cig. Plug double adaptor FREE! Valued at $11.45. (Limit stocks last)

6 Channel IR remote Volume Control KIT

(SC 'Mar/April 2002) Use one IR remote control to simultaneously adjust the volume of up to 6 channels. Perfect for Dolby 5.1 channel, active speaker & DIY surround sound systems. Supplied with deluxe screened, punched and powdercoated case.

$249
K 5600

SUPER BONUS OFFER! Free A1013 remote control with every K 5600, valued at $36.00.

Features: Attractive slimline 1U case, screened and punched, for that professional finish • Compatible with most pre-programmed IR remote controls • 240V operation • Easy to build • Minimal signal degradation and low noise circuit

Orders received by 2:00PM WST Country areas please allow an additional 4 - 10 days. May 2 Kits. No dangerous goods. Not available to PO boxes.

Express Order Hotline 1-300 797 007

1-300 789 777 • fax order line • www.altronics.com.au • on line ordering

ALTRONICS

Optic Fibre Cutters

Optic fibre must be cut with high quality blades to ensure cable integrity. These cutters are ideal for installers, technicians or anyone working with optical fibres

$25 T 1490

Auto Ranging DMM

Autoranging multimeters are great if you don't have a free hand to change ranges on your DMM. Ideal for service persons or hobbyists. **Was $65!**

Features • Manual override of autoranging • Range hold & data hold • Auto power off •°C Temperature range • AC - 400mV to 600V • DC Volts - 400mV to 600V • Resistance - 400Ω - 40MΩ • Continuity buzzer • AC/DC current - 400µA - 10A • Transistor tester • Diode check • Rubber holster included • 3 year warranty

Includes K-Type Temp Probe.

$58 Q 1132

Universal Fast Charger

(SC June/July '01)

Fast charges almost every type of battery !

Fast Charges NiCads, NiMHs, SLAs, LiIONs, Bike batteries, Car batteries. . . IT'S THE ONLY BATTERY CHARGER YOU WILL EVER NEED, EVER AGAIN!

$199 K 1672

It can have your tools operational in a short time, charging your power tool batteries in less than 15 minutes for a 1.2Ah Nicad pack. It includes full battery protection and employs end-of charge detection to ensure that the cells are not damaged. **Was $229.95**

Features: • 1.2, 2.4, 3.6, 4.8 , 6 ,7.2, 9.6, 12, 14.4V voltage steps • Time out & fuse protection • NiCad refresh • 240V operation

Programmable Timer Module

Suits 12/24V DC systems. Contacts rated at 8A, 120VAC/24VDC. Timer adjustable from 1 second to 60 minutes. Ideal for security systems, alarm panels, access control panels etc..

Easy to install and use!

$45 S 0100

MICRON 45W Soldering Station!

We've sold thousands of these soldering stations over the years and its one of our most reliable and robust products! An excellent multipurpose soldering iron ideal for the enthusiast, service technician or for use in a production department.

Features: • Ceramic heating element • Rapid heat-up & heat recovery • Heater insulation of over 100MΩ • Zero voltage circuit prevents damage to sensitive devices • Continuous temperature adjustable from 250° to 430°C • Grounded power cord • **Was $129**

Save $30!

$99 T 2443

• 60W Hot Melt Glue Gun •

A great tool for both home or workshop. Use it to glue together wood, plastics, paper, cardboard and ceramics. Very simple to operate, just turn it on, insert a glue stick, wait 5 minutes and your away!

$14.95 T 2940

Features: • Handy bench stand • Non drip nozzle • Flow control trigger.

BONUS DEAL!
Purchase a T 2940 and receive 2 packets of small glue sticks (12 pcs) valued at $5.20 FREE!

Rodo 50W GAS IRON GO-ANYWHERE SOLDERING!

A gas iron for the busy technician, this little iron packs a HUGE 50 watts of heating power and can solder for up to 1 hour!

Why drag out long extension leads for your mains operated iron?

$36.50 T 2595

SUPER SPECIAL! Purchase a T 2595 and receive a roll of T 1100 solder and a T 2449 butane refill, valued at $11.50 FREE!

THE SUPER STUDENT PACK IS BACK!

Perfect for the budding enthusiast!

Contains a **T 2420** soldering iron, **Q 1053** multimeter, and **T 2753** sidecutters. Perfect way to start off your toolbox or get the essential tools of the trade without breaking the bank! Exceptional value for under $50! Normally $63.55!

$49 ZX1500

FLAMELESS HEATGUN

Was $35.00

Reduces heatshrink or bends plastics quickly and effectively without burning it!
Features: Regulated temperature • Reliable piezo ignition • Uses T 2475 refillable cartridge • No direct flame • Safety ignition lock

$29 T 2480

100W of Soldering Bliss!

This 100W iron eliminates the need to run long extension leads each time you want to solder away from your work bench! It features a "one-touch" piezo ignition for super-easy starting, and a thumb-wheel heat control. An absolute MUST for installers, mobile technicians, on-site service personnel, etc. *Supplied complete with solder tip and bonus blow torch attachment.* **Was $72.50**

$55 T 2598

BONUS DEAL!
The first 20 callers to purchase a T 2598 receive a roll of T 1100 solder & a T 2449 Butane Refill, together valued at $11.50 FREE!

BENCHTOP POWER SUPPLIES

These power supplies are ideal for service work, project design & testing a wide range of electronic appliances.

0-30V, 3A

Features: Delivers up to 3A • Separate controls for voltage and current limiting • Fixed 12V & 5V output rails • Precision LCD voltage & current meters • Fully adjustable from 0 - 30V • Fully regulated • Short circuit & overload protection • **Was $269**

$199 M 8200A

Save over $40!

0-30V, 5A

Features: Delivers up to 5A • Separate controls for voltage and current limiting • Fixed 12V & 5V output rails • Fully adjustable from 0 - 30V • Precision LCD voltage & current meters • Fully regulated • Short circuit and overload protection • **Was $329**

SAVE $30!

$299 M 8205

SURGE & SPIKE PROTECTED POWERBOARDS

by POWERTRAN

Spend up to $30 and save literally thousands!

Inexpensive insurance for your mains powered equipment. These power boards are ideal for small businesses, home offices & expensive home theatre / hi-fi systems.

Features: Thermal circuit breaker/ power switch • 6 outlets (P 8141 & P 8151) • RF filter to reduce EM interference • Overload surge protection • Long power cord • Telephone protection (P 8151 & P 8131)

$20 Single: P 8131 | $25 6 Way: P 8141 | $30 6 Way + Ph: P 8151

Impact Punchdown Tool

Seats wire into Krone® and 110 style terminal blocks. Features adjustable tension and storage for spare blade. Ideal for installers. **Was $59**

Terminate Cat5/6 in a flash! Why pay $100 or more?

$55 T 1602

Super Bright LED Torches

Featuring super bright high intensity white LED's. The clip on model (3 LED) is handy for fisherman, bushwalkers or just to keep in the glove box. The keyring model is a single LED for finding keyholes in the dark.

$14.95 Keyring: X 0192

$29.95 Clip On: X 0195

Press 'n' Peel PCB Film

Ideal for making your own projects! **Easy as 1,2,3:**
1. Photocopy/Laserprint
2. Iron onto PCB
3. Etch your board!

Pack of 5 A4 sheets. **Was $34.95**

$31.50 H 0770

Make your own PCB's and save a fortune!

Orders received by 2:00PM WST. Country areas please allow an additional 24-48 hours. Max. 2 Kgs. No dangerous goods. Not available to Resellers.

on-line ordering: www.altronics.com.au • fax order line 1-300 789 777

ALTRONICS 14 day money back guarantee

PIC® Auto Ammeter Kit

(SC June 2002) An ammeter kit is essential for monitoring your cars electrical system and battery. A programmed PIC chip allows for much easier kit production and simplified circuit.

NEW!

$74.95
K 4336

Remote Volume Controller Kit

(SC June 2002) This remote control volume kit can be built into just about any audio project. New PIC based model can be controlled by most commonly available learning remotes.

NEW!

$49.95
K 5026

The Battery Guardian Kit

(SC May 2002) Stop your car fridge from running your battery flat. ***Features:*** 10A rating • Low power consumption • Cutout alarm • LED indication of cutout • Automatically re-connects battery power

NEW!

$47.95
K 4080

Headphone Volume Controller Kit

(SC May 2002) A great effective line level amplifier kit for headphones. Crank up the volume on your PC sound card or listen to DVD/CD's at the sound level you prefer.

NEW!

$19.95
K 5506

Minimitter

(SC April '01) Mini FM transmitter capable of driving a dipole antenna.
Was $39.95

$30
K 1125

Multi-Power Supply

(SC 'April 2002) An inexpensive, but very flexible bench top power supply. Ideal for R&D

$89.95
K 3200

Features: Six selectable steps- ±3,5 ,6 ,9, 12 & 15V DC • Use 9-15V range at the same time as 3-6V range • Independent load switching • Regulated rails

LAN Cable Tester

This unit will not only check all 8 conductors, but it will also check shielding integrity where shielded cable has been used. PLUS it can also check Coax wiring with the included BNC to RJ45 adaptor!

$129
D 3010

Features: • Auto/Manual mode • LED indicators for all connections including Ground • Will test 10Base-T, 10Base-2, RJ45, 25B, TIA 568A/568B and Token Ring • BNC to RJ45 Adaptor included • Includes Soft carry case

Suitable for up to 8 pin modular connectors, PLUS BNC connectors!

• Was $179

SAVE A TOTAL OF $92!

Purchase the D 3010 and we will give you one of each of the adaptors below. **Total value $42.00 !**

D 3024	RJ45 - BNC	$10.50
D 3025	RJ45 - USB "A" Type	$10.50
D 3026	RJ45 - PS/2	$10.50
D 3027	RJ45 - 8 Pin DIN	$10.50

UHF Remote Control

This learning remote can be used to combine several remotes or replace an old broken one. Suits things like garage doors, car or bike alarms, home alarm, etc. • 4 easy program buttons • Wide operating frequency 260-500MHz *Not suitable for code-hopping alarms

Don't pay up to $48 elsewhere!

$30
A 1015

Was $41.95

Flush Mount Siren

Perfect internal piezo siren for gypsum or tile ceilings. Single flush mount push fit means a quick unobtrusive installation. 54mmØ.

$14.95
S 6122

Ideal for alarm or emergency systems

AUTOMOTIVE Relays

Suitable for all automotive applications such as alarms, lighting etc.. Easily mountable. 30A and 60A models available both 12V DC Coil, SPDT

Ideal for car spotties!

$6.50
30A: S 4335

$8.90
60A: S 4339

STROBE/SIREN COMBO

Combination siren and strobe in a single weatherproof housing. 10-14V. Features separate input for siren and strobe. **Was $30.40**

$25
S 5415

Save time, space AND money!

MICRON SURESHOT!

Desolders a 14 pin IC in around 30 seconds!

The T 1280 makes it a breeze to remove components from any PCB, even double sided, through-hole plated boards. All it needs is a squeeze or two on the trigger and the component virtually falls out.

2 tips supplied.

$299
T 1280

BONUS OFFER!
FREE Bench stand to suit. Valued at $35 with every T 1280

Regulated Benchtop Supply

Delivering 3V, 4.5V, 6V, 7.5V, 9V and 12V at up to 1A continuous capacity, the output voltage varies only minimally from full load to no load making it ideal for voltage sensitive devices like portable TV sets, video games, tape recorders, radios, scanners, computers.

$38
M 8230

Was $49.95 SAVE 22%!
Includes Short Circuit, Thermal & Overload Protection!

PIR DOOR MINDER AND ALARM

Excellent unit for use in home, office, shops,etc. 2 modes:
• Entry/exit chime activated by an external switch or by movement detected • Alarm mode, when activated the alarm sounds for 30 seconds. Features: 10m detection range • Easy to install • Self-contained • Swivel mount bracket • Remote doorbell contacts for monitoring two entryway's • Ideal as a travellers intruder alarm

$30
S 5320

Similar models elsewhere sell for $100 or more!

• Was $42.50

Precision Screwdrivers

Chrome vanadium shaft, rubberised handle
Full set of 5 drivers includes:
Flat blade; **T 1932** 2mm, **T 1936** 3mm.
Phillips; **T 1942** #00, **T 1944** #0,
T 1946 #1

$19
T 1946S

Normally $24.75

Place a priority Internet order NOW!
• www.altronics.com.au •

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PRODUCT SHOWCASE

600W Digital power amplifier modules available in Australia

While we have yet to see many digital amplifier products, these digital modules are available right now. To look at the module with its modest board dimensions of 85 x 53mm, you would be justified in thinking that it was rated at around 60W or thereabouts.

Wrong! This LC Audio Technology ZP0200 module is rated at up to 200W into 8Ω loads, up to 400W into 4Ω and up to 600W into 2Ω.

When you consider the power ratings, the size and wire gauge of the air-cored 80 microhenry output choke no longer seems excessive. This choke is inside the negative feedback loop to ensure stability with any capacitive load but it also leads to a variable high frequency cut-off depending on the load impedance.

Quoted frequency response figures are DC – 91kHz for 8W, DC – 45.5kHz for 4W loads and 20Hz to 22.5kHz for 2W loads.

Supply voltage requirements are from ±30V up to ±60V, depending on the desired power output. Efficiency at 200W into 8Ω is quoted at better than 90%. When multiple modules are operated, the are run in synchronous mode, with all running on the same pulse width modulation (PWM) frequency. Signal to noise ratio is quoted as 105dB A-weighted while total harmonic distortion is .07% at 200W into 8Ω at 1kHz. These are pretty impressive ratings.

The ZP0200 modules are priced at $375 each. You can find out more information at http://www.soundlabsgroup.com.au/LCAudio/LC_Audio_ ZAPpulse.htm

Contact:
Soundlabs Group
Ph: (02) 9660 1228 or (03) 9859 0338
Website: www.soundlabsgroup.com.au

Australian electric glass furnace

A new design electric glass melting furnace has been introduced by B & L Tetlow of Blackburn, Vic, Australia.

The process is based on initially preheating the raw glass material to the point where it becomes electrically conductive.

Power then "shorts" through the glass, raising temperatures up to 1650°C.

Furnace operation is controlled from a remote main control cubicle which contains full instrumentation — including three main temperature controllers/programmers, two over temperature controllers, three SCR power controllers (one specially designed to control the booster electrodes) plus other ancillary equipment and components.

Contact:
B&L Tetlow
Ph: (03) 9877 4188 Fax: (03) 9894 1974
Website: www.tetlow.com.au

Matrix Multimedia bonus PIC CDs

UK-based Matrix Multimedia have announced that all Version 2 Development Boards will now include free Lite/shareware versions of their best-selling range of PIC mciro CD ROMs, including C for PICmicros Lite, Assembly for PICmicro microcontrollers Lite and Flowcode for PICmicros Lite

All three products are compressed onto a single CD ROM which also includes the PPP programming utility and other PICmicro related resources.

Contact:
Matrix Multimedia Ltd
The Factory, Emscote St South,
Halifax, UK HX12AN
Ph: 0011 44 870 700 1831
Web: www.matrixmultimedia.co.uk

IP65-rated cases from Altronics

To further complement their already comprehensive range of enclosures, Altronic Distributors now stock a range of cost-effective ABS enclosures suitable for direct mounting to a wall or switchboard.

Consisting of five different sizes all models include integral mounting ears for easy fixing to walls, recessed front and rear panel to accept Lexan panels, plus moulded stand offs for accepting PC boards.

All are moulded from UL94 ABS material.

Sizes available:

80L x 60W x 40Hmm
125L x 80W x 50Hmm
125L x 100W x 60Hmm
175L x 125W x 70Hmm
200L x 150W x 70Hmm

Contact:
Altronic Distributors
Ph: 1300 780 999
website: www.altronics.com

Microgam's new USB range

Microgram Computers have introduced several new USB dervices into their range. Included is are external cases with a USB 2.0 interface for IDE drives, CDROMs etc. They are available for 2.5-inch (Cat No. 6710-7; rrp $149.00); 3.5-inch (Cat No. 6711-7; rrp $209.00); and 5.25(Cat No. 6689-7; rrp $259.00) drives and are backwards compatible with USB 1.1 ports.

There is also a USB Print Server, which avoids the need for a computer just to operate as a printer server. Or you can avoid slowing down a work station when a print job is running by installing this printer server. It will host two USB printers and one parallel printer and connects by attaching a UTP cable to the nearest hub. It supports pretty well all operating systems, including Windows 95/98/98SE/ME/NT 4.0/2000/XP, Mac OS 8.1 or higher, UNIX/Linux, NetWare (Bindery/NDS). Its Cat No. is 11362-7 and has a rrp of $399.00.

Finally, there is a USB Magnetic Card Readern (Cat No. 1008001-7; rrp $299.00) which is programmable to extract the segment of the data you require. While the physical interface is USB, it can be programmed to operate as a keyboard wedge or alternatively as a serial device.

More information, including product data sheets, are available from the Microgram website.

Contact:
Microgram Computers
Unit 1, 14 Bon Mace Close,
Berkeley Vale NSW 2261
Ph: (02) 4389 8444 Fax: 1800 625 777
Website: www.mgram.com.au

AA-battery powered soldering iron from Electus

Electus Distribution has released a handy battery powered soldering iron that operates on just 3 x 1.5V AA batteries.

The lightweight, Japanese made 6W soldering iron solves many of your tricky soldering applications, enabling you to solder almost anywhere.

It is a delight to use, heats to soldering temperature within ten seconds and boasts an approximate 60 minute run time. A slide switch engages the iron and a momentary push button activates the heat which is also indicated by a high-brightness LED. Tip temperature is around 500°C.

With a recommended retail price of $ 74.95, the Cat No TS-1286 is serious tool for the professional on the go.

Contact:
Electus Distribution
Locked Bag 45, Silverwater NSW 1811
Ph 1300 738 555 Fax 1300 738 500
Web: www.electusdistribution.com.au

New software integrates design models and measurements

Mathematica Link for LabVIEW bridges National Instruments LabVIEW graphical development environment and Wolfram Research *Mathematica* technical computing software to help engineers and scientists more easily acquire and analyze measurements throughout all phases of the design process.

Mathematica Link for LabVIEW combines the data acquisition, analysis, and graphical user interface capabilities of LabVIEW and the modeling and analysis algorithms of *Mathematica* to speed development of custom applications in hundreds of industries, from quantum mechanics to automotive.

With this software, engineers can control a LabVIEW application (Virtual Instrument or VI) from *Mathematica* or access *Mathematica* from within a LabVIEW VI.

Mathematica Link for LabVIEW features built-in, high-level functions for creating a communication path between LabVIEW and *Mathematica* to achieve seamless integration throughout the design flow, from the first mathematical model to validating the final design.

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Website: www.ni.com/australia

Special price on a Fluke+

Fluke Corporation has announced a limited time offer of its 179 Fluke true-rms digital multimeter and ToolPak magnetic hanging kit for a special price.

The Fluke 179 is designed for industrial professionals who require accuracy and the ability to withstand on-the-job rigorous use. Made by Fluke in the U.S., the 179 is built to the world's toughest safety and durability standards.

The Fluke ToolPak meter hanging kit provides the accessories necessary to hang the Fluke 179 meter almost anywhere, including a universal hanger, a magnet and a 23cm

Aussie controller for world markets

SPLat is an Australian developed user-programmable embedded controller that is being successfully marketed worldwide.

There are SPLats assisting disk drive manufacturing in Malaysia and controlling turn-stiles at a famous mansion in the US. A US pharmaceutical research company is planning to use SPLat to control crystal growth experiments on the Space Shuttle.

The SL99 is a second-generation SPLat controller designed for applications with modest I/O requirements. It features 16 digital I/O points plus 2 analog I/O.

A simple add-on board can provide up to 6 more analog or digital special purpose I/O points such as temperature measurement or fluid level switching. An expansion connector allows digital I/O expansion up to 48 points. The SPLat programming language is extremely easy to use for simple timing and sequencing tasks but has the sophistication to allow complex control applications of several thousand instructions.

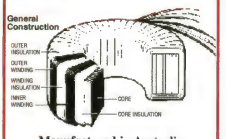
All I/O points include real-world interface circuitry. The inputs are designed to interface switch contacts or NPN sensors, while the outputs are low-side Darlington switches rated up to 400mA. All I/O points have indicator LEDs. Plug-in connectors simplify installation in OEM applications.

An RS232 port is used for programming and communications. SPLat's LiveData protocol gives access to I/O and RAM during program execution, and is available as an ActiveX control to simplify development of supervisory and telemetry applications.

The SL99 will be officially released at Austronics 2002 (Melbourne Convention Centre, October 15-17th).

Contact:
SPLat Controls
2/12 Peninsula Bvde, Seaford Vic 3198
Ph: (03) 9773 5082
Website: www.splatco.com.au

TOROIDAL POWER TRANSFORMERS



Manufactured in Australia
Comprehensive data available
Harbuch Electronics Pty Ltd
9/40 Leighton Pl. HORNSBY 2077
Ph (02) 9476-5854 Fx (02) 9476-3231

Fast new digital camera from Ricoh

Elsewhere in this issue we look at the very up-market Canon EOS D-60 digital camera. Here's another to choose from - but this one is not only priced way under stratospheric levels, it's also claimed to be the fastest shooting camera in its class.

While the resolution of the new $799 Ricoh Caplio RR30 is a fairly typical 3.34 megapixels, it's the shooting response time which sets it apart. At just 0.22 seconds it allows reliable capture of action shots so that what you see is what you get. Many digitals can take a second or so from the time you push the button to the time the shutter actually fires.

In addition the Caplio RR30 offers three different continuous shooting modes that capture up to 16 shots in 2 seconds – perfect for analysing that golf or tennis swing!

The Caplio RR30 features a 'One Touch Review' mode that allows the user to instantly review the last shot taken on the bright LCD screen without having to change to playback mode. This facility means that shots can be reviewed and deleted if not wanted immediately. Ultimately this makes the whole digital process much more efficient as unwanted shots can use up valuable memory space if not deleted.

Ricoh has addressed the problem battery life of digital cameras with the Caplio RR30 featuring the longest genuine rechargeable battery life currently on the market. Using the li-ion battery included with purchase, it can take up to 350 shots between charges with normal usage and up to 3,500 shots can be taken when operating with minimum power consumption. For improved versatility, the Caplio RR30 is also compatible with universally available conventional or rechargeable AA batteries **SC**

Contact:
Ricoh Australia
Ph: 1300 363 741
Website: www.ricoh.com.au

"hook-and-loop" hanger strap. The universal hanger fits into a special module on the back of the meter, allowing users to hang the meter on a nail, hook or other object. The hook and loop strap is used with Fluke's universal hanger to wrap around and connect to a pipe, beam or any other convenient support structure. The strong magnet attaches to an electrical panel, metal door jamb or any other ferrous-type metal.

Contact:
Fluke Australia
Ph: (02) 8850 3333 Fax (02)8850 3300
website: www.fluke.com

Upload your microcontroller code in seconds with this new, PC-serial-port-connected programmer design.

AVR ISP SERIAL PROGRAMMER

This project will allow you to erase and rewrite the program and data memory in your AVR micro in a flash – without even removing it from the application circuit.

Design by STEPHEN DAVIES
Words by PETER SMITH

Back in the October 2001 issue of SILICON CHIP, we described an AVR ISP programmer with similar capabilities to those detailed here. The original design connects to your PC's parallel port, with just one low-cost IC providing buffering between the SPI interface and parallel port lines. The emphasis of the design was on ease of construction and low cost.

This new design is slightly more complex but it provides a number of useful additional features.

For a start, most PCs have a free serial port, whereas the parallel port may already be used for a printer or scanner. Serial port interfaced devices are generally much more robust, too; there are no issues with inserting and removing the connector with power applied, and cable length is relatively unimportant.

Best of all, support for the AVR ISP Serial Programmer is already built right into AVR Studio. This means that you can assemble, debug and then program your AVR micro, all within the same application. By contrast, the October 2001 design needs a separate application to perform the programming part of the cycle.

AVR Studio, by the way, is a complete set of PC-based development tools for use with Atmel's AVR microcontroller family. It includes a project manager, source editor, assembler and simulator – and it's free!

Serial versus parallel programming

A potentially confusing aspect of AVR programming involves the terms "serial" and "parallel". Most AVR devices can be programmed using a low-voltage "serial" method or a high-voltage "parallel" method.

With serial programming, the RESET pin is held low while data is exchanged over a 3-wire Serial Programming Interface (SPI). No special programming voltages are required; the microcontroller's supply pin remains within its normal operating range (usually 2.7-6.0V).

Conversely, with parallel programming, the microcontroller must be supplied with 5V whilst the RESET pin is driven to 12V. In addition, eight bits of data are transferred simultaneously rather than the bit-by-bit transfer of the serial mode. In all, fourteen distinct signals are required in parallel programming mode, making it considerably more difficult to implement.

In-system programming

The advantage of the low-voltage serial programming method is that it allows in-system programming (ISP). In-system programming means just that. There's no need to even remove the AVR micro from its socket in order to reload program and/or data memory. In many cases, all you need to do to make use of this feature in your designs is provide a connection point (the ISP header) for the programmer. The block diagram in Fig.1 shows how it all hangs together.

Fig.2 shows how the ISP header would be hooked up in a typical design. The AVR micro shown in this example uses the same pins for both the SPI signals (MOSI, MISO and SCK) and the upper port B I/O signals - PB5, PB6 & PB7. During normal operation, these three pins behave like all the other port I/O lines. However, when RESET is held low, the alter-

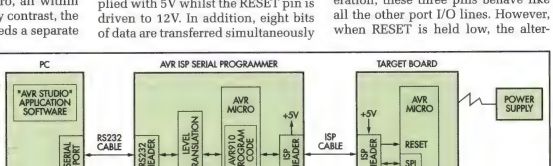


Fig.1: the programmer connects between your PC and the target board. Power is provided by the target board, thus eliminating the need for a separate supply.

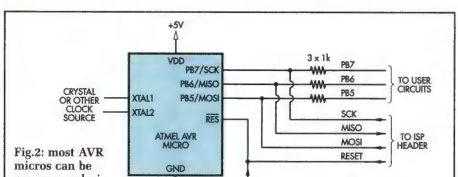


Fig.2: most AVR micros can be programmed via a 3-wire Serial Programming Interface (SPI). It's just a matter of wiring the SPI signals to a header for connection to our programmer. In some cases, you may also need to add three 1kΩ resistors, as shown here.

this "bridge" is needed because PC serial ports and SPI ports are entirely incompatible.

Data is sent and received over the PC serial port lines at RS232 voltage levels (up to +/-12V). Translation to standard TTL levels (0 – 5V) is performed by IC1, a MAX232. This device incorporates a charge pump voltage doubler and inverter for generation of the required positive and negative voltages, hence the need for the 1uF capacitors.

Unlike the PC interface side, the Serial Programming Interface operates at TTL voltage levels (0 – 5V). The SPI consists of three signal lines, namely: MOSI (Master Out Slave In), MISO (Master In Slave Out) and SCK (Serial Clock).

The microcontroller (IC2) is considered the serial bus "master". It controls the SCK line, sending serial data on MOSI and receiving data on MISO. It also controls the target micro's RESET line, driving it low to activate SPI (programming) mode.

Connection to the target board is made via a 6-pin single-row header (CON3) or a 10-pin dual-row header (CON2). Pinouts for both headers are shown in Fig.5. The 10-pin header is optional. We've included it in the design because it tends to be the most common type in use on AVR development boards.

Low-voltage operation

Power for the programmer is derived from the target board. As shown, the programmer is designed to operate from 4.5-5.5V. However, some microcontroller variants can operate over a much wider voltage range. For example, the AT90S1200-4 and AT90S2313-4 are

nate SPI function is selected and programming operations can commence.

Notice the three 1kΩ resistors in Fig.2. They provide a measure of isolation between the user circuits and the SPI signals. This works well if the I/O pins are used for inputs only or when used for outputs, if they only need to sink or source a few mA of current. A universal solution is shown in Fig.3, where the user circuits are isolated with an analog multiplexer when in programming mode (RESET signal low).

Of course, the simplest solution of all would be to incorporate jumpers or DIP switches in the design, so that the user circuits can be completely disconnected from the port pins when the programmer is connected.

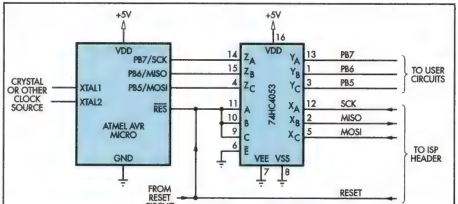


Fig.3: an analog multiplexer can be used to completely isolate the user circuits during programming

Fuse bits

At this point, you're probably wondering why we need the parallel programming method at all. Serial programming does the job, with fewer signals and at a lower voltage, doesn't it? Well, yes - almost. The fuse bits on most devices can only be programmed with the parallel method.

Fuse bits are used to control several important microcontroller features. They can be thought of as non-volatile switches. When on, the respective feature is enabled and when off, it is disabled.

Fuse-selectable features vary according to device, so check your micro's data sheets for details. In most cases, the factory-programmed fuse settings are fine for general use, so this serial programmer is probably all you'll ever need!

By the way, all AVR devices, with the exception of the AT90S8534, ATTiny11 and ATTiny28, support in-system programming.

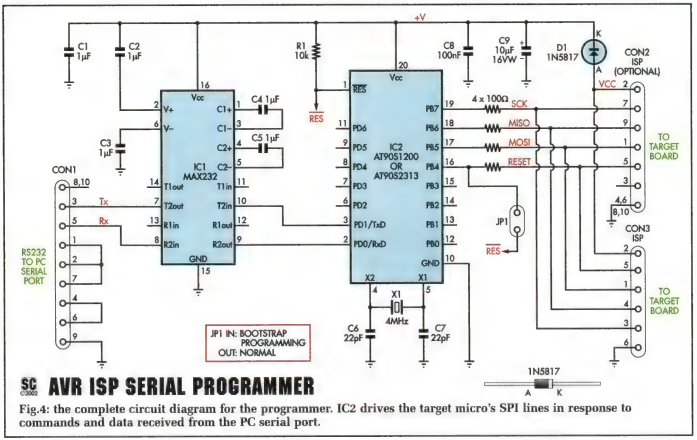
How it works

As you can see from the circuit diagram in Fig.4, there really isn't much to the hardware side of the AVR ISP Serial Programmer. Most of the hard work is done by IC2, an AVR microcontroller.

The design incorporates two serial interfaces. One connects to your PC's serial port and the other to the SPI port on the microcontroller to be programmed. Conceptually, the microcontroller (IC2) can be thought of as an intelligent "bridge" between these two interfaces. As you've probably guessed,

Table 1: Supported devices

ATTiny12	AT90S4433
ATTiny15	AT90S8515
AT90S1200	AT90S8535
AT90S2313	Atmega83
AT90S2323	Atmega103
AT90S2343	Atmega161
AT90S4414	Atmega163



AVR ISP SERIAL PROGRAMMER

Fig.4: the complete circuit diagram for the programmer. IC2 drives the target micro's SPI lines in response to commands and data received from the PC serial port.

specified for 2.7 – 6.0V. Higher speed devices such as the AT90S1200-12 and AT90S2313-10 are specified for 4.0 – 6.0V only.

If you're likely to be using the programmer with designs powered from less than 4.5V, then several points need to be considered. Firstly, you'll note that we haven't specified a speed rating for IC2 in the parts list. Any speed device (-4, -10 or -12) will work OK in the programmer if the target board supplies between 4.5 and 5.5V. However, for low-voltage operation, you should choose the –4 (4MHz) part.

In addition, you will need to replace IC1 with a MAX3232 (or equivalent) device, suitable for operation down to 2.9V. By the way, we've nominated 2.9V instead of 2.7V, as this is the minimum programming voltage shown in the most recent Atmel errata sheets.

Finally, you'll need to replace D1 with a wire link. Although we've specified a Schottky diode here, even its 0.2V drop will be too high at these low voltage levels. D1 provides reverse polarity protection but is unnecessary if you use the specified header sockets and plugs. These are polarised (keyed) and therefore impossible to accidentally reverse.

Having said all that, we believe that the programmer will probably function right down to 2.9V even without the lower-voltage components. No guarantees though!

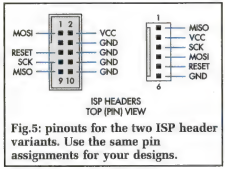
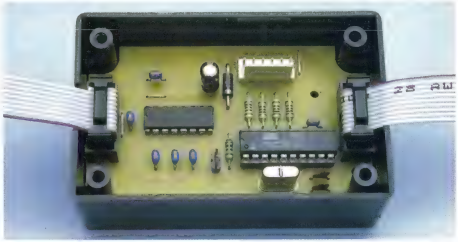


Fig.5: pinouts for the two ISP header variants. Use the same pin assignments for your designs.

Microcontroller choices

This project is based on Atmel's application note AVR910. Atmel's original design calls for an AT90S1200 device for IC2. We've retained support for this device, and included the option of using an AT90S2313 as well. The latter device is a little more expensive, but we believe that some en-



The PC board is a snug fit inside the case - so snug, in fact, we didn't worry about any mounting screws. Your PC board might need some minor surgery on the corners (with a file) to ensure it fits past the case corner pillars.

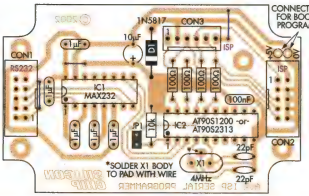
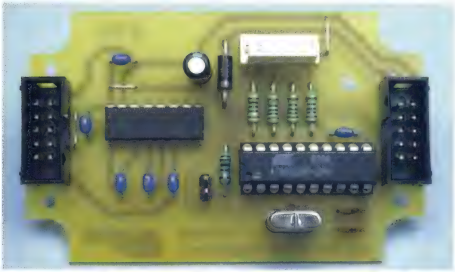


Fig.6: the overlay diagram with full-size PC board pattern shown "ghosted" underneath. The two pads above CON2 are for temporary connection to an external 5V DC supply (needed only during bootstrap programming).



This photograph of the completed PC board is actually larger-than-life so you can clearly identify the components and their placement.

thusiasts will already have a spare one or two of these in their parts bin!

The AT90S2313 is pin-compatible with the AT90S1200 but includes extra goodies such as SRAM, a UART and more program (Flash) memory. The designer has modified Atmel's original program so that it will run on the AT90S2313 but a little more on that shortly.

Construction

Referring to the overlay diagram in Fig.6, begin by installing the three wire links. Next, install all of the resistors followed by diode D1. Be sure to align the cathode end of D1 (indicated by a white band) as shown.

The remaining components can be installed in any order you wish but leave the crystal (X1) and the connectors (CON1 – CON3) until last. CON1 and CON3 (optional) should be aligned with pin 1, or the polarised side, facing towards the middle of the board. When soldering, make sure that the connectors are seated firmly against the PC board surface.

The crystal (X1) is mounted in the vertical position. Once in place, use a length of tinned copper wire to attach the body to the ground pad underneath, shown marked with an asterisk (*) in Fig. 6.

Note that if you have a pre-programmed microcontroller (IC2), as would be the case if you've purchased a kit, then there is no need to install JP1. This 2-pin header and its associated jumper shunt are only required for bootstrap programming, which we'll look at shortly.

Fig.7: the RS232 cable is made up using two crimp-style IDC connectors. Note that the header plug has one more pin than the 'D' connector does. This is easily handled by crimping the header plug first, then stripping back the 10th conductor and snipping it off where it enters the header.

Cable assembly

A minimum of two cables is required for a working setup, so we'll describe them first. For connection to your PC's serial port, you'll need a length of 9-way IDC cable with a 9-pin male 'D' connector on one end and a 10-way header plug on the other. Cable length is not critical and can be up to 1.5m or more. Fig.7 shows the details.

For connection to your target boards, a much shorter length of 6-core data cable or 6-way rainbow cable is required. We recommend a maximum length of about 250mm. Each end should be fitted with a 6-way header plug, wired pin to pin (see Fig.8).

If you own one of the many development boards that use 10-way headers for the ISP connection, then you'll want to make the optional 10-way cable. All that's required is a 250mm length of 10-way IDC cable with an IDC header plug on either end.

Bootstrap programming

As with any other micro project, the program (Flash) memory in IC2 needs to be programmed before it will perform as designed. **If you've purchased this project as a kit, then the micro will already be programmed. You should skip this section and go directly to "Housing".** However, if you've sourced all the bits individually, then you'll

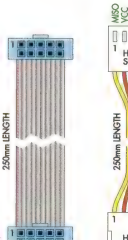


Fig.8: connection from programmer to target board is via one of these ISP cables.

need to program IC2 yourself.

The program files for IC2 are available from the SILICON CHIP web site at www.siliconchip.com.au. If you have an AT90S1200, then download the AVR910a.ZIP file. Alternatively, for an AT90S2313, download AVR910b.ZIP. Inside these .ZIP files you'll find both the assembled (.HEX) file ready for upload to the micro as well as the source (.ASM) file.

If you have access to another (working) ISP programmer, simply connect it to one of the ISP headers (CON2 or CON3), hook up an external 5V DC supply and you're ready to upload the code. We've provided a convenient connection point for the external supply in the form of two spare pads, situated just above CON2. Refer to the overlay diagram (Fig.6) for details. Oh, and you'll need to install a shorting link on JP2 during programming, too.

Don't have access to a working programmer? No problems – we've devised a method of "bootstrap programming" IC2 to cater for this very dilemma! You'll need a free parallel port on your PC, a "bootstrap programming" cable, an external 5V DC @ 50mA power source and Windows programming software. Let's make the cable first.

Using a 450mm length of data cable or rainbow cable, solder a 25-pin male 'D' connector to one end and a 6-way header socket to the other. Fig.9 shows the pin connections. For connection to an external power source, solder two lengths of hook-up wire to the spare pads situated just above CON2 (see Fig.6).

Next, download and install the Windows programming software. The software we've selected is called "PonyProg", and it's available free from www.lancos.com. PonyProg runs on Windows 95, 98, ME, NT4 and 2000 and requires only minimal hardware.

After installation, power down your PC and connect the bootstrap programming cable. One end connects to CON3 on the programmer and the other to your PC's parallel port. Install a shorting link on JP1 and hook up the external 5V DC power source (watch the polarity). Hold your breath and switch on.

Now power up your PC and launch PonyProg. You'll see messages to the effect that "setup" and "calibration" need to be run before proceeding, so let's do that first.

The following functions are all accessible from the menu bar at the top of the main window. First, select *Setup -> Interface Setup*. In the window that appears, choose the "Parallel" option. In the drop-down list,

Parts List – AVR ISP Serial Programmer

1 PC board coded 07110021, 78.5mm x 49.5mm
1 82 x 54 x 31mm (L x W x H) plastic instrument case (Jaycar cat HB-6015, Altronics H 0205)
1 4MHz crystal (HC49 package, parallel resonant) (X1)

Semiconductors
1 MAX232 RS232 line driver/receiver (IC1)
1 AT90S1200 microcontroller (IC2) programmed with AVR410a.HEX **–or-**
1 AT90S2313 microcontroller (IC2) programmed with AVR410b.HEX (see text)
1 1N5817 or 1N5819 Schottky diode (D1)

Capacitors
1 10µF 16V PC electrolytic
5 1µF 50V monolithic (multilayer) ceramic
1 100nF 50V monolithic (multilayer) ceramic
2 22pF 50V ceramic disc

Resistors (0.25W, 1% metal film)
1 10kΩ
4 100Ω

Connectors & cable
1 10-pin dual-row shrouded (boxed) PC mount header (CON1)
1 10-pin IDC cable mount socket
1 9-pin IDC female 'D' connector
1 6-pin 2.54mm pitch single-row PC mount header (CON3)
2 6-way header sockets to suit CON3
1.5m 10-way IDC cable (for serial cable)
250mm 6-core data cable or 6-way rainbow cable (for ISP cable)
50mm (approx.) 0.71mm tinned copper wire (for links)

Additional parts for 10-way ISP cable (optional, see text)
1 10-pin dual-row shrouded (boxed) PC mount header (CON2)
2 10-pin IDC cable mount sockets
250mm 10-way IDC cable

Additional parts for bootstrap programming (not required if IC2 is supplied pre-programmed)
1 6-way header socket to suit CON3
1 25-pin male 'D' connector
1 2-pin 2.54mm pitch single-row PC mount header (JP1)
1 jumper shunt (for JP1)
450mm 6-core data cable or rainbow cable

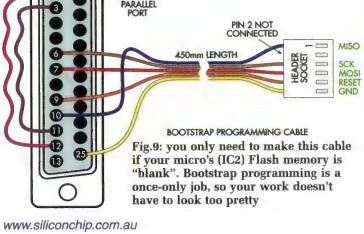


Fig.9: you only need to make this cable if your micro's (IC2) Flash memory is "blank". Bootstrap programming is a once-only job, so your work doesn't have to look too pretty

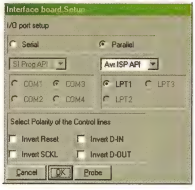


Fig.10 (left): PonyProg can be configured in just a few seconds. Our "bootstrap" programmer is compatible with Atmel's STK200/300 parallel port programmer, identified here as an "AVR ISP". Don't check (tick) any of the "Invert" boxes!

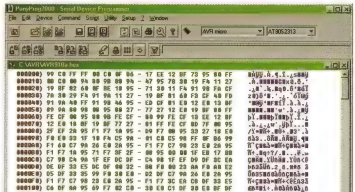


Fig.11 (right): this is what you should see after successfully loading the program (.HEX) file.

choose "AVR ISP API" if you're running Windows 95, 98 or ME, or "AVR ISP I/O" if you're running Windows NT4 or 2000 (see Fig.10). Click on the OK button to close the window.

Next, select *Setup -> Calibration*. Follow the displayed instructions to run the calibration. To complete the basic settings, select *Device -> AVR Micro* and choose your micro from the long list of supported devices.

Before "burning" the micro, you need to load the program code. Select *File -> Open Program (FLASH) File*. From the "Files of type:" drop-down list, change "*.e2p" to "*.hex". Next, navigate to wherever you unzipped AVR910a.ZIP (or AVR910b.ZIP, see above) and double-click on the appropriate .HEX file. The .HEX file is loaded and displayed in the edit window (see Fig.11).

OK, it's programming time.

Select *Command - > Write Program (FLASH)* and the Status window appears. If all goes well, you'll get a "Write successful!" message. If you get an error message instead, use the *Command -> Erase* function and try again.

Once you've managed to successfully program the micro, close PonyProg, power down your PC and disconnect the programming cable. Switch off the 5V power source and remove the associated hook-up wire, as well as the shorting link on JP1. All done!

Housing

A little surgery is required in order to fit the completed assembly in the specified case. Cut away the integral card guides of the case so that you're left with reasonably smooth internal surfaces. This can be done with sidecutters or a sharp knife (mind the pinkies!).

The PC board should now slide all (or most) of the way into the case. As the board nears the bottom, it should "wedge" in place, held firmly by the sides of the case. For a more permanent installation, you can attach the board to the bottom of the case using 6mm stand-offs, 10mm M2.5 screws and M2.5 nuts.

For ribbon cable exits, file small flat slots in the lip of the case so that the cables just fit when the lid is closed.

If you've used data cable for the 6-way ISP cable, file an appropriately sized slot in the lip on one end, or alternatively, drill a hole and fit a grommet.

Using the programmer

The AVR ISP Programmer integrates with Atmel's AVR Studio as well as a number of other commercial development packages.

AVR Studio can be downloaded free of charge at ftp://www.atmel.com/pub/atmel/astudio3.exe.

No special configuration is required to get your programmer working with AVR Studio. Simply connect the RS232 cable to a free COM port (COM1 to COM4 is supported), connect the ISP cable to the target board and apply power. To activate the programmer from within AVR Studio, hold down the 'Alt' key and press '9'. The "AVRprog" window should appear, (see Fig.12).

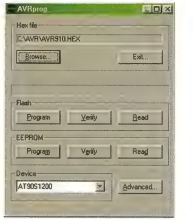


Fig.12: AVRprog is invoked within AVR Studio by holding down 'Alt' and hitting '9'.

A stand-alone version of the programming software is also available. Download it at ftp://www.atmel.com/pub/atmel/aprogwin.exe.

Die-hard DOS fans can download a DOS version from ftp://www.atmel.com/pub/atmel/aprogdos.exe

Want to know more?

Atmel's application note titled "AVR910: In-System Programming" should be consulted first. You'll find it on Atmel's web site at www.atmel.com.

For details on programming specific microcontroller types, refer to the data sheets, available from the Atmel site. **SC**

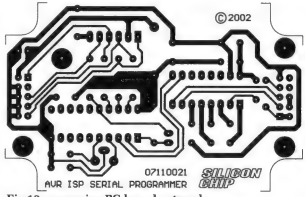


Fig.13: same-size PC board artwork.

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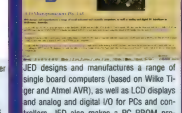

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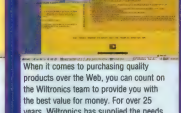

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VINTAGE RADIO

By RODNEY CHAMPNESS, VK3UG

The Radio Corporation WS122

In May 2002, the AWA FS6 army transceiver was described. This month we cover another military transceiver, the WS122. This was a much more portable set, requiring only three men to carry it!

The WS122 as a type or model number will mean nothing to many readers, while others will become dewy-eyed dreaming of their beloved WS122 that they used many years ago. Commonly the "WS" was dropped off the type number; it simply stood for "Wireless Set".

The 122 is one of several different portable high frequency (HF) radio transceivers used during World War II by the Australian Army. As mentioned above, in May 2002 I described the AWA FS6, a popular HF transceiver from the same period. After reading this article you will see that these two transceivers are as different as chalk and cheese.

The WS122 (Aust) was the final unit in a series of sets which had their start in the British-designed 22 set. Radio Corporation (Eclipse Radio Pty Ltd) was charged with the job of building an Australianised version of the English 22.

Their first attempt was something like the British 22 and probably not much different in performance or facilities.

They then built the "Yellow Band"

Not exactly a thing of beauty, this WS122 war-time military transceiver was still being widely used in Victorian rural fire services until the 1980s. Its transmitter output valve is an 807.

This photo shows the WS122 ready for service with power supply and ancillaries hooked-up. The protective grille at the front made it difficult to operate and most users discarded these.

22 (Aust). It had an Australianised circuit using American and Australian designed valves and while still a grid-modulated transmitter, it used only one 807 valve in the transmitter output section. I doubt that this was a particularly common set. I've never seen one anyway.

However, Radio Corporation felt that they could do better. Their design engineers really got the bit between their teeth and came up with the 22 (Aust) set. This was soon partnered by the 122 (Aust) set which was identical except that it had provision for crystal control as well as variable frequency control (VFO) of the transmitter operating frequency.

The 122 remained in service until the mid 1950s when it was progressively replaced by the No 62 set.

Early interest

In my mid teens, I became interested in radio communications and was itching to be able to use radio transmitters and receivers.

My chance came in 1957 when I became involved with the local Emergency Fire Service (EFS) in country South Australia. I was given a much-modified Type A MkIII transceiver (described in the October 1998 issue) to use at fires for communications back to base in a nearby town.

I ultimately built my own transceiver, based on designs in "Radio & Hobbies". It worked well but it could not be licensed for fire brigade radio communications. However, it was acceptable for amateur radio use.

I moved to rural Victoria in 1961 and joined the local Country Fire Authority (CFA) radio communications network.

A couple of radio friends leant rather heavily on me to get a 122 – "the best transceiver since sliced bread, just what you need". I was far from convinced, as looking inside their sets and looking at the circuit diagram was enough to give me the horrors. How would I find my way around the insides of the set and understand the circuit?

I was, to say the least, scared of such complex (to me) military equipment. No doubt new collectors feel much the same as I did at that stage. Fortunately, I gradually overcame that fear.

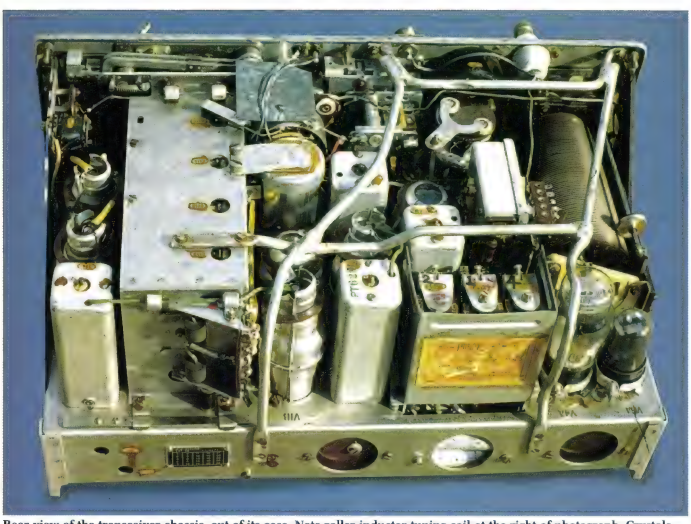
Anyway, they succeeded in convincing me to part with some hard-earned cash and I bought a 122. I set the transceiver up in my vehicle as one of the local licensed mobile stations for the CFA on a frequency of 2692kHz.

I took it out to show my friends and they immediately commenced the "modification" process to get it to look like all the other 122 transceivers used in the various CFA networks. So if the set which is the subject of this article doesn't look quite original, you'll understand why.

These sets proved very popular in the HF fire brigade networks. They were not expensive to buy, they worked well after a routine service and they could be licensed without any modifications to the electronics. The owners and operators became rather fond of these big, bulky, complex and complicated-to-operate sets.

They were also popular with amateur radio operators who used them as mobile and portable transceivers during the late 50s and into the 60s.

The power supply used two vibrators. The third one is clipped in as a spare.



Rear view of the transceiver chassis, out of its case. Note roller inductor tuning coil at the right of photograph. Crystals are mounted near the back at the lefthand end of the chassis.

They were finally retired from service in the 1980s. What a phenomenal run, from the early 40s to the 80s!

Originally, the 122 came into use around 1942 as an army portable HF transceiver operating between 2MHz and 8MHz. It operates from a 12V battery and can be used as a ground station, vehicle station or a man-pack station.

As a man-pack station, it was carried by three men, one carrying the transceiver, one the ancillary parts like the power supply, headphones, aerial wire, etc and one the 12V 20 amp-hour battery.

The transceiver cabinet top side is designed like an "A" frame back-pack (as can be seen in one photograph) to make carrying the set easier (or perhaps less difficult!). The load was distributed so that no man carried more than 35 pounds (16kg). The set itself weighs 15kg.

The set could also be fitted with immersion covers to stop water getting into the set when amphibious landings were required. However, this was really a "belts and braces" approach as the set was already well sealed against ingress of moisture.

All the rotating controls have rubber seals around the shafts, the toggle switches have rubber boots (these have all perished on my set and have been removed) and the edges of the cabinet and transceiver front have rubber seals too. The phone type jacks each have a spring-loaded cover with a rubber gasket. This is held against the jack opening to prevent water getting into the set via this route.

If this wasn't enough, the cabinet has a Silica Gel capsule screwed into the back of the cabinet. This can be screwed out for replacement from time to time. So the set was extremely well protected against ingress of water.

50 years on, the seals are largely ineffective due to the rubber perishing. And while rubber was used in some areas, the actual wiring is in plastic coated hook-up wire - quite an innovation for the time. This is probably the best protected set I've come across of its era. Many of the components were/are coated in "tropicalising gunk".

The set has an aluminium chassis and the protection bars and other bits and pieces are Duralumin.

As can be seen from the photographs, the transceiver is very complex, with lots of components in and on the chassis. The valves are held in position by clamps to ensure that they do not come out of their sockets due to rough handling.

The power supply is equipped with a spare vibrator and three fuses. The set itself has a relay-adjusting tool in a holder on the back of the chassis; all very handy.

There are two sets (red and blue) of mechanical preset tuning adjustments that can be adjusted to allow rapid selection of two frequencies. The ad-

Under chassis view showing the shielded RF section compartment and the crowded wiring.

justments are similar in concept to the pushbutton tuning on older car radios. These are locked with the screwdriver located on the top right of the front panel.

With the front protection grille in place, the set is not easy to operate but quite OK once it is removed. Most of us just threw these grilles away.

Certainly it is far from an easy set to service. Some parts are extremely difficult to gain access to. However, considering the amount of parts there are, the set is quite reasonable to work on, provided you're not in too much of a hurry to get the job done.

Receiver valve line-up

The receiver uses a total of seven 2V battery valves, with a 1D5GP radio frequency (RF) amplifier, followed by a 1C7G as a mixer. The intermediate frequency (IF) stages use a further two 1D5GP valves while a 1H6G functions as detector and delayed automatic gain control (AGC). Note that the triode section of the 1H6G isn't used in the receiver – only in the transmitter.

The audio stage is an 1F5G audio output type valve and in the receiver it only feeds two pairs of headphones. (The 1F5G has sufficient gain and output to feed a speaker in a modified set.)

In Morse code (CW) mode, the beat frequency oscillator (BFO) is another 1H6G valve.

The receiver is designed to receive AM, MCW and CW transmissions which it does quite competently. With careful tuning and attention to the radio frequency gain, the receiver can also adequately tune single sideband transmissions.

One attribute it has which is not common on portable military equipment is a meter measuring the effect of the AGC voltage in controlling the gain of the RF and IF sections of the receiver. This is very handy for determining the relative strength of received signals.

In amateur radio, this feature is usually called an "S-Meter" which equates to "signal strength meter". Its reading is useful in aligning the receiver and transmitter circuits.

Transmitter valve complement

The transmitter has two RF stages. The VFO and crystal oscillator is a 6U7G (V5A). This stage drives the output valve which is an 807 (V7A) small transmitting tetrode.

The FS6 described in May 2002 uses grid modulation but the 122 uses the much more efficient plate and screen modulation method.

The modulator is much more elaborate than that used in the FS6. The 1D5GP used as the 2nd IF amplifier is also used as the first audio amplifier in the transmitter, followed by the triode section of the 1H6G (receiver detector/AGC).

The next stage is the receiver audio output stage and modulator driver (1F5G). This drives the modulator valve which is a 6N7 run as a push-pull class-B stage.

To my knowledge, the 22 (Aust) and the 122 (Aust) were the only portable, mobile, man-pack military transceivers that used such a sophisticated (for that time) modulation system, except for the ATR4.

The transmitter has three modes of operation: voice (radio telephony - RT, AM); Morse (CW) and Modulated Continuous Wave (MCW).

On voice, a press-to-talk button on the microphone is used to change over from receive to transmit.

The microphone has a dynamic insert which explains why so many audio stages are necessary to achieve full modulation; a carbon microphone has greater output but poorer audio quality. In addition, the quality of the audio being transmitted can be monitored through the headphones.

On CW, the Morse key is depressed and the unit changes over automatically to transmit. It has what is called "semi-break-in" keying.

A tone (sidetone) in synchronism

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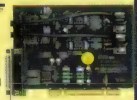

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Photo Gallery: STC Model 5017A

A product of STC (Sydney), the model 5017A uses the same chassis as the STC 5017 but is housed in an alternative cabinet style. This example is from 1936. This set covers the medium wave band and uses the following valves: 6A7 frequency changer; 6D6 IF amplifier; 6B7 first audio/detector/AVC amplifier; 42 output and 80 rectifier.

with the Morse key is heard in the headphones. This sidetone makes it so much easier to check the quality of the signal. The modulator is inactive in this mode.

MCW is the same as for CW, except that the modulator is operating and a tone is transmitted in synchronism with the operation of the Morse key.

Vibrator power supplies

The power supply is really two supplies, both based on vibrators. One supply is used to provide the HT (150V) for the receiver.

On low power transmit, the same supply is used and it is switched to provide 180V to the transmitting valves. On high power transmit, the two vibrator power supplies are connected in series to provide 250 to 260V on MCW and voice and 320 to 360V on CW. It is well-filtered which reduces vibrator hash to a very low level.

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General Overhaul

As mentioned earlier, my 122 had been modified to suit work on the Country Fire Authority radio networks. Some of the modifications could be easily reversed but some had to be left "as is", hence the non authentic look of the set in places.

Generally, the components in the sets have been quite reliable and very few needed replacement. If you are going to work on one of these sets it is imperative to obtain a handbook, as the sets are very complex (for their time) and difficult to work on.

In the back of the transceiver case is a circuit diagram of the set and in the power supply is a copy of its circuit. These are better than nothing but are hard to follow.

I replaced a few paper capacitors in the audio sections. On transmit, I found I could tune the transmitter up and obtain good output but then the output would just die away. The plate current of the 807 was dropping but the HT voltage was remaining constant.

The problem was that the 807 had lost its emission and a replacement soon fixed that. I suppose that after 40-odd years it was entitled to be tired.

The 1D5GP receiver RF valve was also slightly weak and was replaced. The 1F5G valve seems to be the one most likely to require replacement from my experience. Every other valve has proved very reliable and long-lasting, despite being bumped around in a vehicle for many thousands of kilometres.

The "crash limiter" is a pair of diodes wired anode to cathode so that any voltage AC or DC above around 0.2V is clipped to that level. It can be switched across the headphone output and is designed to limit the effect of static crashes.

This it does but it also severely limits the audio output and distorts it. Radio amateurs thought it was useless and I didn't use it.

I wired another four diodes (1N4148) in the same way as the original diodes and put these in series with the existing ones. This improved the audio quality while still retaining the static reducing ability.

I decided that it would be a good idea to check the alignment of the transmitter and receiver circuits. I tackled the receiver first.

I found that the intermediate frequency (IF) alignment was peaked on 460kHz so it was left alone. That's close enough to the designed 455kHz anyway. The RF and oscillator sections are not so easy to get at, particularly for the 2 to 4MHz band.

The slugs are horizontal, going into the large below-chassis shielded enclosure and are well down in the chassis amongst a lot of components.

Great care is needed to avoid shorting anything. I couldn't even get a screwdriver onto them and had to use a pair of long-nosed pliers to laboriously rotate the slug cores; a bit of butchery but the only way of adjusting these coils. The 4 to 8 MHz cores are accessible for use with a screwdriver.

Surprisingly the adjustments were quite close, only requiring a touch-up.

The alignment of the transmitter involves making sure that the receiver and transmitter tuned circuits, particularly the respective oscillators, all track one another.

I won't go into all the procedure necessary to achieve this, suffice to say the alignment and adjustment details are straight-forward and unambiguous.

As some of the tuned circuits are common to both the receiver and the transmitter, it is necessary to make sure that the compensating networks within the equipment are adjusted correctly too, otherwise the transmitter and receiver do not operate on quite the same frequency under some circumstances.

Note that the transmitter variable frequency oscillator (VFO) (receiver equivalent is the local oscillator) runs at half the output frequency. This prevents the transmitter output getting back into the VFO (if it was on the same frequency) and causing instability.

On receive, I found the 122 would quite effectively detect CW signals down to around a microvolt – it's not as sensitive as modern day sets.

The transmitter came up very well. On low power the radio frequency output was around 3W. On high power AM and MCW, the output was around 7W and on CW, 13W.

The modulation waveform was not marvellous as observed on the oscilloscope but 100% modulation was quite easily obtained.

Summary

Many vintage radio buffs who collect military equipment, find this set very interesting and well worth having.

The 122, like virtually all military sets, will not win any beauty contests but then they were never intended to. It is a credit to Radio Corporation (Eclipse) that this set, old as it is, is still capable of doing work to the same standard as when it was made.

While its facilities and circuit techniques are now obsolete, it was a very advanced military transceiver in its day and it has a number of facilities that were not incorporated into amateur radio equipment until the 1960s. **SC**

Vintage radio feedback

As an old radio man who cut his teeth on valve radios, I always enjoy Rodney Champness' "Vintage Radio" feature. But Rodney, my un-met friend, something you said in the June 2002 issue is driving me bananas because I don't understand it.

In describing the Tasma M290 superhet radio, you point out that the local oscillator padder capacitor works best if placed where the Tasma M290 has it, in series with the oscillator tuning gang rather than in series with the earthy side of the oscillator coil.

What's the difference? In either case, the oscillatory circuit consists of the oscillator coil with two capacitors in series across it. Seeing that the oscillator is not "tickled" into activity by phase changes across the parallel resonant circuit (it has a separate tickler coil), what does it matter to circuit operation where the earth point is placed in the circuit? That's the only physical difference I can see, the effective placement of the earth point.

The only technical difference I can see is that the padder placement you call "best", in fact puts the dynamic Miller capacitance of the valve grid across the whole oscillator circuit instead of (with the other padder placement position) across just one of the series capacitors (the tuning gang). For circuit constancy, wouldn't it be better to put the padder capacitor in series with the earthy side of the oscillator coil to slightly improve the dynamic stability of the oscillator circuit?

Stan Hood,
Christchurch, NZ.

It is always good to get comment from readers and I appreciate Stan Hood of New Zealand for taking the time to do so. At the outset I certainly don't claim to be the font of all knowledge on vintage radio or design. These are my thoughts on why the local oscillator does work better when the padder capacitor is in series with the capacitor and not the earth end of the oscillator coil. One side of the original padders was earthed, therefore using them in the earthy end of the coil was convenient and it worked. When fixed padders became common most manufacturers carried on the convention. However, some put the padder in series with the tuning capacitor.

I used to wire all my receivers with the padder to earth just as "Radio & Hobbies" had done. I accepted is as "the" way to do it and never questioned it. However, I ran into trouble with a receiver that would drop out of oscillation on the low frequency end of the dial. All I did was to shift the padder to be in series with the tuning capacitor and the problem vanished. I've since done this modification to a few receivers and the results have all been favourable.

It may be remembered that 2A7s and 6A7s were prone to drop out of oscillation on the low frequency end of tuning ranges. This modification has cured any sets that I've had this problem with. It also seems to improve the sets' sensitivity.

I do believe that either the phase of the feedback is changed or the amount of feedback is reduced or maybe both. The effect may also vary depending whether the feedback winding is near the grid end of the tuned winding or near the so-called earthy end. Looking at the typical circuit redrawn, it does look like a cross between a Colpitts and a "tickler" feedback type circuit.

With the tuning capacitor fully meshed, the coil would appear to be "centre tapped". When tuned to the high end, the electronic tapping point has moved down near to the padder capacitor. With the padder in series with the tuning capacitor the coil always has the bottom of the coil referenced to earth and therefore the feedback would be more predictable.

All I can say it works better with the padder in series with the tuning gang.

Rodney Champness,
Mooroopna, Vic.

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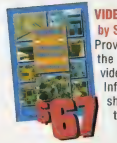

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Increasing the rating of the Battery Guardian

Thanks for the Battery Guardian (SILICON CHIP, May 2002). It is exactly what I need for my solar power system but I would like to increase the current available from the circuit to about 20A. Could I increase the size of the heatsink, parallel another Mosfet with Q1 or parallel the entire driver portion? Or is there a better way? (R. P., via email).

● *The Mosfet should be paralleled with another STP60NE06 and provided with a heatsink. Also the fuse should be a 3AG 20A type (using 3AG fuse holder clips in the extra holes on the PC board).*

Ideally the wider current carrying tracks on the PC board should be made heavier by applying a thick layer of solder over them. Be careful that the tracks are not overheated and begin lifting off the board. An alternative would be to wire between the component leads in parallel with the PC tracks using insulated hookup wire.

Connector confusion in Theremin kit

I recently got my hands on one of your Theremin kits (SILICON CHIP, August 2000) and have more or less finished putting the whole thing together. But I still have one question, regarding the AC adapter.

Because I am located in Canada and could not get the exact model number you stated, I picked up a generic one which will fit the bill. The thing is that I am not sure about the tip polarity required for the Theremin and I can't seem to find the information in the literature provided. Could you help me out? (M. E., Fredericton, Canada).

● *If you have a look at the PC board wiring diagram you will see that the DC socket has the tip connected to positive. Make sure your DC plugpack is the same and if you can't change it, swap the wiring in the DC socket to suit.*

Earthing fuel tanks for safety

I was in a garage the other day and was told to put my jerrycans on the ground before filling them. When I asked why I was told that it was to earth them. Sounds reasonable. So I asked what about the fuel tank in my car? The reply was that it was earthed and was OK. The attendant had just been to a safety seminar run by a big fuel company and this is what he was told by the experts. We are now having a running argument.

I say that the fuel tank and the whole car are NOT earthed and the attendant and fuel company say that it is. Who is right? (M. D., Warwick, Qld).

● *The important thing is that the fuel tank is grounded to the car – this was a problem with the plastic fuel tanks on Falcons a few years ago because the metal filler was not earthed to the car. The problem is a buildup of electrostatic charge on the fuel tank (or jerry-can).*

Anyway, why not put the jerrycans on the ground when filling them? They get heavy otherwise!

Sanwa taut-bandanalog meter wanted

Please can you ask your readers if anyone has a 1983 Sanwa N-501/D analog multimeter they would like to sell. It has a taut band suspension. Thanks a lot.

Mike Sheriff,
Phone (02) 9949 2454
email colbox@zip.com.au

Ignition system for a Ferrari

I have a 1979 Ferrari 308. I am looking to change over to a distributorless ignition system. My goal is to use GM type coils and a GM type ignition module to eliminate the distributors. My dilemma is that I do not have a system to control spark advance, and I am not sure of the best method for determining cam or crank position.

This Ferrari has a magnetic type pickup in each distributor, and has two distributors, one for each cylinder bank. I have a rear drive pulley that is attached to the back of on of the cams. If I had a cam position sensor I could locate it here. I want to know if your programmable ignition system (SILICON CHIP, June & July 1999) will solve my problems. (D. B., via email).

● *Forget about the PIT module; it is too crude for car use. We would suggest you don't eliminate the distributors but possibly convert them to reluctor or Hall effect pickup. Then build our HEI system (SILICON CHIP,*

How to do bifilar winding

I am an electronics enthusiast in the UK. I recently purchased a kit from Altronics for the 15W class A amplifier and power supply (SILICON CHIP, July & August 1998). However, I am a little stuck over the power transformer. Altronics don't seem to do a 20V + 20V model now so I bought a 100VA 20V + 20V EI transformer over here but it ran very hot. I now have a larger toroidal 18V +18V unit but it runs on the limit of regulator drop out.

In the second part of the project (August 1998) you put extra windings on the 18V + 18V model used for the prototype. These windings were wound bifilar. Could you explain (in reasonable detail please) how I go about adding windings myself – it's the "bifilar" bit I'm not sure about. (S. F., via email).

● *Bifilar merely refers to the technique of doing the two windings at the same time; ie, get hold of two wires and wind them on as one. You then terminate them as if they were two separate windings, which is exactly what they are.*

June 1998). That way you retain the necessary spark advance.

Diagnosing motor problems

I know this is a bit out of your area but I would like your opinion. I have a motor which quit while running. Now all it will do is run under no load for a few seconds after switch-on. My hope is that this behaviour indicates failure of the external capacitor rather than the motor windings. The motor nameplate rating is 240V 3A @ 50Hz. The capacitor's legend is too damaged to read. It is a plastic cylinder 7cm long and 3.5cm in diameter. (F. M., Temagog, NSW).

• *Whatever is the problem, you should check the capacitor. If you don't have a capacitance meter you can still do a very rough capacitance check using the continuity test on an analog multimeter and then compare it with a known good capacitor. We'd be hopeful too, and would suspect the capacitor.*

Smoke precipitator for home fires

I have a suggestion for a project. There was a big conference in Adelaide recently on the dangers of wood smoke. Surely a smoke precipitator such as used in industry is not much different to an ioniser – maybe a good project? (C. H., Daw Park, SA).

• *Smoke reduction generally involves a combination of bag chambers and electrostatic precipitators, neither of which are simple or inexpensive. However, wood smoke also has the hazard of creosote and noxious gases. These could probably be removed by a water spray system but again, it is not a simple or cheap system, especially in Adelaide where water is at a premium.*

Bridging a Playmaster amplifier

We have just recently purchased a Playmaster Pro-3 Stereo Amplifier from Jaycar Electronics and we were wondering is it possible to link the two output channels together so as to double the output power. We only need one channel and the specifications provided don't mention anything about whether we can bridge the two outputs together. (S. J., via email).

Soft start for car headlamps

I recall seeing in "Circuit Notebook", probably in the last 3 years, a simple circuit for `soft starting' 12V car headlamps.

As I use high powered (145/90W) halogen headlamps this `soft start' circuit would be very useful in prolonging the life of these very expensive bulbs.

I have looked up your website (great site and very easy to navigate) but cannot find reference to it. I believe it used a simple Mosfet circuit which did not apply full voltage to the bulbs at switch-on but gradually increased voltage over a period of milliseconds. Again, if my recollection is correct I think there was a relay in the circuit which bypassed the Mosfet once full voltage was reached.

Could you please tell me if you have this circuit and how I may obtain it? (S. P., via email).

• *You are probably referring to a circuit which appeared in the October 1997 issue. This was a modification of the 12/24V speed controller (see June 1997) using the "soft start" facility at pin 4 of the TL494. We can supply these issues for $7.70 each, including postage.*

• *You need the Bridge Adaptor board published in the June 1985 issue of Electronics Australia. We can supply a photostat copy of the article for $8.80 including postage.*

Curing noisy volume controls

I had a clock radio which developed a noisy volume control years ago. I found a quick squirt of WD-40 cured the problem instantly and permanently. It is over five years since I sprayed this particular volume control and it is still silent.

I've used this trick many times since. Someone suggested I ought use an electrical lubricant spray but I tried others and there is just no substitute for WD-40. It really works!

Many volume controls are "specials" and can be very difficult to replace. With the WD-40 technique there is no need to replace them at all. (R. D., Salisbury Heights, SA.

• *Thanks for the tip.*

Video/audio transmitter kit cannot be found

I have purchased and built the video/audio transmitter kit (SILICON CHIP, July 1999). It works but I am using it on a TV out of the computer graphics card (Geforce 200, 64MB) and the problem is that it won't detect the video/audio module. I can use a TV with the video card with no problems, and then plug in the transmitter and the system works until I shutdown and restart. It then searches for the TV and unable to find it, it then turns off the second monitor.

Is there a way to make the kit detectable by my graphics card? (M. M., via email).

• *Your video card is probably looking for a 75Ω load. Try loading the video output with a 75Ω resistor or two 150# resistors in parallel.*

Universal preamplifier has insufficient gain

I equipped community radio station 3GDR with three of your excellent universal preamplifiers (SILICON CHIP, April 1994) and was impressed enough to buy a fourth kit and try it out on my Onkyo turntable. Alas, it turns out that I have an Audio Technica moving coil cartridge. The output is way down and the hum level is up. Anything I can do or do I work out another way of using the preamplifier at the radio station? (B. G., via email).

• *Alas, you need a moving coil preamplifier. Electronics Australia described one in July 1981. We can supply a photostat copy for $8.80 including postage.*

Speed Alarm for a motor home

I have built the Speed Alarm described in the November & December 1999 issues and installed it in my Land Rover Discovery; it works perfectly. I have modified it with leads and sockets so I can also use it in my Motorhome.

I was unable to obtain 0.18mm enamelled wire so I have wound 500 turns of 0.20mm enamelled wire onto

Electric guitar preamp modifications

I'm interested in a modification to the guitar preamp from the November 2000 issue. I wish to use one channel for a conventional lead or rhythm guitar and the other channel for a bass.

What I'd really like to do is modify the tone control circuit somewhat to make the turnover frequencies around 500-600Hz for the midrange and 2.5-3kHz for the treble controls. (There's not too much 10kHz out of a bass!)

I feel that by simply altering the values of the capacitors around the mid and treble control pots, I can achieve this. I have done some calculations and come up with the following: Substitute 4.7nF (.0047uF) for the 2.7nF (.0027uF) capacitor across the mid pot; substitute 18nF (.018uF) for the 12nF (.012uF) in series with the mid pot and substitute 4.7nF (.0047uF) for the 1.5nF (.0015uF) in series with the treble pot.

By my calculations this will result in turnover frequencies of around 600Hz and 3000Hz for the mid-range and treble controls respectively. Do you agree with these figures? G. F., via email).

• *Your modifications will be suitable. As you have discovered, it is simply a matter of scaling the values to suit your required frequencies.*

a slightly larger plastic bobbin (20mm OD x 9mm ID x 9mm). My question is will it work? I also have the following questions. First, is it necessary to set the speed alarm to read 100km/h before calibrating as per your instruction for calibrating at 60km/h? Second, I am told the speedo in the Motorhome is out by 5km/h. What effect will this have? (J. L., via email).

• *You can use a larger bobbin for the coil pickup sensor without any problems. In fact the larger core will enable the speed alarm to register at very slow speeds as well.*

If you wish to calibrate the speed alarm at 60km/h you need to set the alarm at 60km/h as well. Calibration at 100km/h requires the speed alarm to be set to 100km/h.

The accuracy of the vehicle speedometer does affect accuracy of the speed alarm. If you know the vehicle speedometer is 5km/h out then you can compensate for this by setting the speed alarm 5km/h different when calibrating. For example, if the vehicle speedometer is known to be showing speeds that are 5km/h faster than the actual speed then the speed alarm can be set to 5km/h less than the speed that it will be calibrated. So if you wish to calibrate at 60km/h as shown on the vehicle speedometer, set the speed alarm to 55km/h before pressing the CAL switch.

Bridging ETI amplifier modules

With reference to the comments on bridging amplifier modules in the August 2002 issue, there was a project and a PC board, the ETI481, a guitar amplifier. Its preamp board enabled the bridging of two of the modules to produce 200W into 8-ohm loads. The PC board provided two out-of-phase outputs, one for each module. (G. V., via email).

• *We are aware that ETI published the 481 Guitar PC board which allowed two 100W modules to be bridged together (ETI, June 1977). The only problem is, the combination can only drive an 8-ohm load. It will however, deliver 200W and not 100W as stated in our answer - must have slipped a cog there*

Increased gain for Neon Tube Modulator

I have built the Neon Tube Modulator from the November 2001 issue and it works well on the bench from my stereo amplifier line outputs. However, when I set it up in my car and drive it with the line outputs from the head unit, you have to turn the volume way up to get the Neon Modulator to respond. Is there any way the circuit can be changed to fix this? (J. E., Wollongong, NSW).

• *It seems you need a mite more gain from the circuit. We suggest increasing the 3.3kΩ feedback resistor for IC1a to 10kΩ or 15kΩ.*

TV pattern generator has no colour bars

I recently purchased a programmable TV Pattern Generator from Altronics. It was described in the June & July 1997 issues of SILICON CHIP. Due to a change in the specifications of the video modulator from the original version Altronics included info concerning modifications to the wiring and overlay to compensate for this change. The changes made were an additional 5.1V 1W zener diode between the 180Ω resistor and REG2 and changes in the wiring points of the modulator using only three of the original four pin outs on the PC board.

My problem is that while the kit works well when displaying the first three patterns (checkerboard, dot and crosshatch + circle). I am unable to display the red raster or colour bars. Also the grey scale is not all that sharp

WARNING!

SILICON CHIP magazine regularly describes projects which employ a mains power supply or produce high voltage. All such projects should be considered dangerous or even lethal if not used safely. Readers are warned that high voltage wiring should be carried out according to the instructions in the articles. When working on these projects use extreme care to ensure that you do not accidentally come into contact with mains AC voltages or high voltage DC. If you are not confident about working with projects employing mains voltages or other high voltages, you are advised not to attempt work on them. Silicon Chip Publications Pty Ltd disclaims any liability for damages should anyone be killed or injured while working on a project or circuit described in any issue of SILICON CHIP magazine. Devices or circuits described in SILICON CHIP may be covered by patents. SILICON CHIP disclaims any liability for the infringement of such patents by the manufacturing or selling of any such equipment. SILICON CHIP also disclaims any liability for projects which are used in such a way as to infringe relevant government regulations and by-laws.

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when displaying the full eight bars from white to black. When I switch S4 from grey scale to colour, it tries to change but remains grey scale. Varying VR2 and VC1 made no changes whatsoever to the colour scale when testing it on my small colour TV.

There don't appear to be any obvious solder bridges on the SMD IC10 on the underside of the PC board and all voltages check OK as per the testing procedures specified in the magazine article. (D. S., via email).

• *The lack of colour may be due to the delay time set by the 2.2kΩ resistor between pins 8 of IC11b and 3,4&5 of IC11c. Try changing the 10nF (0.01µF) at the IC11c inputs to a larger value.*

Also the 270pF capacitor added at IC10's pin 16 input may need to be made slightly larger in value to obtain colour.

Cranking difficulties with Austin A1300

I have a problem with the High Energy Ignition project described in the June 1998 issue. I have installed it in an Austin 1300 which is used infrequently. The circuit produces no spark while the starter motor is cranking the engine. I can only start the engine by towing/rolling down a hill or changing over to the HEI once the engine is warm when the engine will run once the ignition switch is released to the running position. What can I do? (G. P., via email).

• *We assume you are using points ignition. The HEI should work even if the battery voltage drops to 6V while cranking. How far does your battery drop? Also check the points gap. Rubbing block wear can reduce the gap to nil. We suggest that you use a larger points gap than specified, to ensure a "clean and fast break" in the points current even when cranking slowly.*

LiL Snooper Camera switcher

I am interested in building the Li'L Snooper camera switcher from the June 2001 issue of SILICON CHIP. I have one question though. The cameras to be used with it are both colour. Is this circuit be suitable for colour cameras; one is CCD, the other is CMOS? If not, can you recommend any mods to make it suitable? (C. L., via email).

• *The Snooper will work with any camera which delivers a 1V composite video signal.*

Low sensitivity in Theremin

I have recently built the Theremin project from the August 2000 issue of SILICON CHIP. It works well but I find the sensitivity and range of the pitch antenna low. This is also the same case with the volume disc but this is not such a problem.

I have earthed myself to the ground plane of the project and this helps but it is still limiting. I was wondering if there is a circuit modification I could do to improve this? This web site http://www.maxiespages.com has many circuit diagrams but none like your unique design. (T. H., via email).

• *Sensitivity to hand movement is dependent on careful tuning of the Theremin adjustments. However, sensitivity is not extreme and is not meant to be. The original Theremins required the hand to be brought very close to the plate or vertical wire for best pitch and volume changes.*

Note that positioning of the Theremin is important and it should not be located near to metal surfaces. Also attaching the lid of the Theremin onto the box can alter tuning and readjustments may be required on a trial and error basis.

A larger diameter plate and larger diameter antenna can also improve sensitivity. **SC**

Notes & Errata

Multi-purpose Fast Battery Charger: June and July 2001. When charging older cells either singly or in series, it is important to ensure that their contacts are clean to prevent voltage drops across these connections.

High resistance connections will prevent the charger from operating correctly as it will detect a high voltage per cell and simply indicate "no Battery".

In addition the connecting leads from the charger to the cell or cells must be rated at 7.5A or more and be no longer than necessary to prevent voltage drops.

K-Type Thermocouple Thermometer/Thermostat, August 2002: The display reading and the thermostat trip point can be affected by RF signals produced by portable and mobile telephones when these are close to the unit. This problem can be cured with the addition of four 100nF (0.1µF) ceramic capacitors and a 1kΩ resistor.

The 1kΩ resistor is placed in series with the probe input connecting to pin 3 of IC1 while one 100nF capacitor connects between pin 3 and pin 4 of IC1. This forms a low pass filter in the input circuit.

The second 100nF capacitor connects between pin 3 of IC1 and ground which is the thicker PC track adjacent to the 10µF capacitor to the left of IC1. The third 100nF capacitor connects between pins 2 and 3 of IC1. The 100nF MKT polyester capacitor connecting between pins 6 and 2 of IC1 (located to the right of IC1 on the PC board) is removed. The fourth 100nF ceramic capacitor connects between pins 2 and 3 of IC2.

To provide for these changes, we have modified the PC board, as shown in this diagram. The modified PC board is coded 04208022 and is available on our website.

Atmel AVR ISP Programming Adaptor (October 2001): The software referred to in the article, avr_isp.zip, is no longer available from the Atmel website. A suitable alternative is "Ponyprog", available for free download from http://www.lancos .com/prog.html. This program also supports Windows NT/2000 and can program many of the newer AVR devices.

To configure Ponyprog to work with the ISP Programmer, set it up for the "AVR ISP (STK200/300) parallel port interface" as described in the included documentation.

Digital Storage Logic Probe, August 2002: the outputs of the 4N25 optocouplers on the circuit on page 24 should be pins 4 & 5, not 5 & 6. The PC board diagrams are correct in this regard.

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December 1991: TV Transmitter For VCRs With UHF Modulators; Infrared Light Beam Relay; Colour TV Pattern Generator, Pt.2; Index To Volume 4.

March 1992: TV Transmitter For VHF VCRs; Thermostatic Switch For Car Radiator Fans; Coping With Damaged Computer Directories; Valve Substitution In Vintage Radios.

April 1992: IR Remote Control For Model Railroads; Differential Input Buffer For CROs; Understanding Computer Memory; Aligning Vintage Radio Receivers, Pt.1.

June 1992: Multi-Station Headset Intercom, Pt.1: Video Switcher For Camcorders & VCRs; IR Remote Control For Model Railroads, Pt.3; 15-Watt 12-240V Inverter; A Look At Hard Disk Drives.

October 1992: 2kW 24VDC - 240VAC Sinewave Inverter; Multi-Sector Home Burglar Alarm, Pt.2; Mini Amplifier For Personal Stereos; A Regulated Lead-Acid Battery Charger.

February 1993: Three Projects For Model Railroads, Low Fuel Indicator For Cars; Audio Level/VU Meter (LED Readout); An Electronic Cockroach; 2kW 24VDC To 240VAC Sinewave Inverter, Pt.5.

March 1993: Solar Charger For 12V Batteries; Alarm-Triggered Security Camera; Reaction Trainer; Audio Mixer for Camcorders; A 24-Hour Sidereal Clock For Astronomers.

April 1993: Solar-Powered Electric Fence; Audio Power Meter; Three-Function Home Weather Station; 12VDC To 70VDC Converter; Digital Clock With Battery Back-Up.

June 1993: AM Radio Tuner, Pt.1: Remote Control For The Woofer Stopper; Digital Voltmeter For Cars; Windows-Based Logic Analyser.

July 1993: Single Chip Message Recorder; Light Beam Relay Extender; AM Radio Trainer, Pt.2; Quiz Game Adjudicator; Windows-Based Logic Analyser, Pt.2; Antenna Tuners – Why They Are Useful.

August 1993: Low-Cost Colour Video Fader; 60-LED Brake Light Array; Microprocessor-Based Sidereal Clock; Satellites & Their Orbits.

September 1993: Automatic Nicad Battery Charger/Discharger; Stereo Preamplifier With IR Remote Control, Pt.1; In-Circuit Transistor Tester; +5V to +15V DC Converter; Remote-Controlled Cockroach.

October 1993: Courtesy Light Switch-Off Timer For Cars; Wireless Microphone For Musicians; Stereo Preamplifier With IR Remote Control, Pt.2; Electronic Engine Management, Pt.1.

November 1993: High Efficiency Inverter For Fluorescent Tubes; Stereo Preamplifier With IR Remote Control, Pt.3; Siren Sound Generator; Engine Management, Pt.2; Experiments For Games Cards.

December 1993: Remote Controller For Garage Doors; Build A LED Stroboscope; Build A 25W Audio Amplifier Module; A 1-Chip Melody Generator, Engine Management, Pt.3; Index To Volume 6.

January 1994: 3A 40V Variable Power Supply; Solar Panel Switching Regulator; Printer Status Indicator; Mini Drill Speed Controller; Stepper Motor Controller; Active Filter Design; Engine Management, Pt.4.

February 1994: Build A 90-Second Message Recorder; 12-240VAC 200W Inverter; 0.5W Audio Amplifier; 3A 40V Adjustable Power Supply; Engine Management, Pt.5; Airbags In Cars – How They Work.

March 1994: Intelligent IR Remote Controller; 50W (LM3876) Audio Amplifier Module; Level Crossing Detector For Model Railways; Voice Activated Switch For FM Microphones; Engine Management, Pt.6.

April 1994: Sound & Lights For Model Railway Level Crossings; Discrete Dual Supply Voltage Regulator; Universal Stereo Preamplifier; Digital Water Tank Gauge; Engine Management, Pt.7.

May 1994: Fast Charger For Nicad Batteries; Induction Balance Metal Locator; Multi-Channel Infrared Remote Control; Dual Electronic Dice; Simple Servo Driver Circuits; Engine Management, Pt.8.

June 1994: 200W/350W Mosfet Amplifier Module; A Coolant Level Alarm For Your Car; 80-Metre AM/CW Transmitter For Amateurs; Converting Phono Inputs To Line Inputs; PC-Based Nicad Battery Monitor; Engine Management, Pt.9.

July 1994: Build A 4-Bay Bow-Tie UHF TV Antenna; PreChamp 2-Transistor Preamplifier; Steam Train Whistle & Diesel Horn Simulator; 6V SLA Battery Charger; Electronic Engine Management, Pt.10.

August 1994: High-Power Dimmer For Incandescent Lights; Microprocessor-Controlled Morse Keyer; Dual Diversity Tuner For FM Microphones, Pt.1; Nicad Zapper (For Resurrecting Nicad Batteries); Electronic Engine Management, Pt.11.

September 1994: Automatic Discharger For Nicad Battery Packs; Minikey Voice Operated Relay; Improved Satellite Night Viewer; AM Radio For Weather Beacons; Dual Diversity Tuner For FM Microphones, Pt.2; Electronic Engine Management, Pt.12.

October 1994: How Dolby Surround Sound Works; Dual Rail Variable Power Supply; Build A Talking Headlight Reminder; Electronic Ballast For Fluorescent Lights; Electronic Engine Management, Pt.13.

November 1994: Dry Cell Battery Rejuvenator; Novel Alphanumeric Clock; 80-Metre QSO Monitor/Transmitter; Twin-Cell Nicad Discharger (See May 1993); How To Plot Patterns Direct to PC Boards.

December 1994: Easy-To-Build Car Burglar Alarm; Three-Spot Low Distortion Sinewave Oscillator; Clifford – A Pesky Electronic Cricket; Remote Control System for Models, Pt.1; Index to Vol.7.

January 1995: Sun Tracker For Solar Panels; Battery Saver For Torches; Simple Pro-Logic Surround Sound Decoder, Pt.2; Dual Channel UHF Remote Control; Stereo Microphone Preamplifier.

February 1995: 2 x 50W Stereo Amplifier Module; Digital Effects Unit For Musicians; 6-Channel Thermometer With LCD Readout; Wide Range Electrostatic Loudspeakers, Pt.1; Oil Change Timer For Cars; Remote Control System For Models, Pt.2.

March 1995: 2 x 50W Stereo Amplifier, Pt.1: Subcarrier Decoder For FM Receivers; Wide Range Electrostatic Loudspeakers, Pt.2; IR Illuminator For CCD Cameras; Remote Control System For Models, Pt.3.

April 1995: FM Radio Trainer, Pt.1: Photographic Timer For Darkrooms; Balanced Microphone Preamp & Line Filter; 50W/Channel Stereo Amplifier, Pt.2; Wide Range Electrostatic Loudspeakers, Pt.3; 4-Channel Decoder For Radio Remote Control.

May 1995: Build A Guitar Headphone Amplifier; FM Radio Trainer, Pt.2: Transistor/Mosfet Tester For DMMs; A 16-Channel Decoder For R/C Receivers; Introduction to Satellite TV.

June 1995: Build A Satellite TV Receiver; Train Detector For Model Railways; 1W Audio Amplifier Trainer; Low-Cost Video Security System; Multi-Channel Radio Control Transmitter For Models, Pt.1.

July 1995: Electric Fence Controller; How To Run Two Trains On A Single Track (Incl. Lights & Sound); Setting Up A Satellite TV Ground Station; Build A Reliable Door Minder.

August 1995: Fuel Injector Monitor For Cars; Gain Controlled Microphone Preamp; Audio Lab PC-Controlled Test Instrument, Pt.1; How To Identify Hard Disk Drive Parameters.

September 1995: Railgower Mk.2 Walkaround Throttle For Model Railways, Pt.1; Keypad Combination Lock; The Vader Voice; Jacob's Ladder Display; Audio Lab PC-Controlled Test Instrument, Pt.2.

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January 1987: How To Network Your PC; Control Panel For Multiple Smoke Alarms, Pt.1; Build A Pink Noise Source; Computer Controlled Dual Power Supply, Pt.1; Digi-Temp Monitors Eight Temperatures.

February 1987: PC-Controlled Moving Message Display; Computer Controlled Dual Power Supply, Pt.2; Alert-A-Phone Loud Sounding Telephone Alert; Control Panel For Multiple Smoke Alarms, Pt.2.

March 1987: Driving A Computer By Remote Control; Plastic Power PA Amplifier (175W); Signalling & Lighting For Model Railways; Build A Jumbo LED Clock; Cathode Ray Oscilloscopes, Pt.7.

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May 1987: Neon Tube Modulator For Light Systems; Traffic Lights For A Model Intersection; The Spacewriter – It Writes Messages In Thin Air; A Look At Signal Tracing, Pt.2; Cathode Ray Oscilloscopes, Pt.9.

June 1987: PC-Controlled Thermometer/Thermostat; TV Pattern Generator, Pt.1; Audio/RF Signal Tracer; High-Current Speed Controller For 12V/24V Motors; Manual Control Circuit For Stepper Motors.

July 1987: Infrared Remote Volume Control; A Flexible Interface Card For PCs; Points Controller For Model Railways; Colour TV Pattern Generator, Pt.2; An In-Line Mixer For Radio Control Receivers.

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December 1987: Speed Alarm For Cars; 2-Axis Robot With Gripper; Stepper Motor Driver With Onboard Buffer; Power Supply For Stepper Motor Cards; Understanding Electric Lighting Pt.2; Index To Vol.10.

January 1988: Build Your Own 4-Channel Lightshow, Pt.1 (runs off 12VDC or 120VAC); Computer Controlled System For Model Railways, Pt.1; Pan Controller For CCD Cameras.

February 1988: Multi-Purpose Fast Battery Charger, Pt.1; Telephone Exchange Simulator For Testing; Command Control System For Model Railways, Pt.2; Build Your Own 4-Channel Lightshow, Pt.2.

April 1988: Automatic Garage Door Opener, Pt.1; 40V 8A Adjustable Power Supply, Pt.1; PC-Controlled 0-30kHz Sinewave Generator; Build A Laser Light Show; Understanding Electric Lighting; Pt.6.

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June 1988: Troubleshooting Your PC, Pt.2; Universal High Energy Ignition System; The Roadies' Friend Cable Tester; Universal Stepper Motor Controller; Command Control For Model Railways, Pt.5.

July 1988: Troubleshooting Your PC, Pt.3; 16-W/Ch Class-A Audio Amplifier, Pt.1; Simple Charger For 6V & 12V SLA Batteries; Automatic Semiconductor Analyser; Understanding Electric Lighting, Pt.8.

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September 1988: Troubleshooting Your PC, Pt.5; A Blocked Air-Filter Alarm; Wau-Waa Pedal For Guitars; Jacob's Ladder; Gear Change Indicator For Cars; Capacity Indicator For Rechargeable Batteries.

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November 1988: The Christmas Star; A Turbo Timer For Cars; Build A Poker Machine, Pt.1; FM Transmitter For Musicians; Lab Quality AC Millivoltmeter, Pt.2; Improving AM Radio Reception, Pt.1.

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March 1989: Getting Started With Linux; Pt.1; Build A Digital Anemometer; Simple DIY PIC Programmer; Easy-To-Build Audio Compressor; Low Distortion Audio Oscillator; Index To Vol.11.

April 1989: Getting Started With Linux; Pt.2; High-Power Electric Fence Controller; Bass Cube Subwoofer; Programmable Thermostat/ Thermometer; Build An Infrared Sentry; Rev Limiter For Cars.

May 1989: The Line Dancer Robot; An X-Y Table With Stepper Motor Control; Pt.1; Three Simple Projects For LEDs; Build A Tuition Monoxide Alarm; Getting Started With Linux; Pt.3.

June 1989: FM Radio Tuner Card For PCs; X-Y Table With Stepper Motor Control, Pt.2; Programmable Ignition Timing Module For Cars, Pt.1; Hard Disk Drive Upgrades Without Reformatting; Computer Sentry.

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December 1989: Solar Panel Regulator; PC Powerhouse (gives +12V, +9V, +6V & +5V rails); Fortune Finder Metal Locator; Speed Alarm For Cars, Pt.2; Railpower Model Train Controller, Pt.3; Index To Vol.12.

January 2000: Spring Reverberation Module; An Audio-Video Test Generator; Build The Proteus Programmable Robot; A Parallel Port Interface Card; Off-Hook Indicator For Telephone Lines.

February 2000: Multi-Sector Sprinkler Controller; A Digital Voltmeter For Your Car; An Ultrasonic Rangefinder; Build A Safety Switch Checker; Build A Sine/Square Wave Oscillator.

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December 2000: Home Networking For Shared Internet Access; Build A Bright-White LED Torch; 2-Channel Guitar Preamplifier, Pt.2 (Digital Reverb); Driving An LCD From The Parallel Port; Build A Morse Clock; Protoboards – The Easy Way Into Electronics, Pt.4; Index To Vol.13.

January 2001: How To Transfer LPs & Tapes To CD; The LP Doctor – Clean Up Clicks & Pops, Pt.1; Arbitrary Waveform Generator; 2-Channel Guitar Preamplifier, Pt.3; PIC Programmer & TestBed.

February 2001: How To Observe Meteors Using Junked Gear; An Easy Way To Make PC Boards; L'il Pocket Amp; Li'l Battery Controller; Make – A MIDI Interface For PCs; Build The Bass Blaster; 2-Metre Elevated Groundplane Antenna; The LP Doctor – Clean Up Clicks & Pops, Pt.2.

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September 2001: Making MP3s – Rippers & Encoders; Build Your Own MP3 Jukebox, Pt.1; Programmable Mains Switch; Two-Channel Noise Source For Tinnitus Sufferers; The Sooper Snooper Directional Microphone; Using Linux To Share An Internet Connection, Pt.4.

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January 2002: Touch And/Or Remote-Controlled Light Dimmer, Pt.1; A Cheap 'n'Easy Automotive Alarm; 100W RMS/Channel Stereo Amplifier, Pt.3; Build A Raucous Alarm; Tracking Down Computer Software Problems; Electric Power Steering; FAQs On The MP3 Jukebox.

February 2002: 10-Channel IR Remote Control Receiver; 2.4GHz High-Power Audio/Video Link; Assemble Your Own 2-Way Tower Speakers; Touch And/Or Remote-Controlled Light Dimmer, Pt.2; Booting A PC Without A Keyboard – A Very Clever Trick.

March 2002: Mighty Midget Audio Amplifier Module; The Itsy-Bitsy USB Lamp; Touch-Sensitive Remote Volume Control, Pt.1; RIAA Preamplifier For Magnetic Cartridges; 12/24V Intelligent Solar Power Battery Charger; Getting Serious About Using Your PC's Sound.

April 2002: How To Get Into Avionics; Automatic Single-Channel Light Dimmer; Pt.1; Build A Water Level Indicator; Multiple-Output Bench Power Supply; Versatile Multi-Mode Timer; 6-Channel IR Remote Volume Control, Pt.2; More FAQs On The MP3 Jukebox.

May 2002: PIC-Controlled 32-LED Knightrider; The Battery Guardian (Cuts Power When the Battery Voltage Drops); A Stereo Headphone Amplifier; Automatic Single-Channel Light Dimmer; Pt.2; Stepper Motor Controller; Stuck Sheet – Keeping The Mains-Eaters At Bay.

June 2002: Lock Out The Bad Guys with A Firewall; Remote Volume Control For Stereo Amplifiers; The "Matchless" Metal Locator; Compact 0-80A Automotive Ammeter; Constant High-Current Source.

July 2002: Telephone Headset Adaptor; Rolling Code 4-Channel UHF Remote Control; Remote Volume Control For The Ultra-LD Stereo Amplifier; Direct Conversion Receiver For Radio Amateurs, Pt.1

August 2002: Digital Instrumentation Software For Your PC; Digital Storage Logic Probe; Digital Thermometer/Thermostat; Sound Card Interface For PC Test Instruments; Direct Conversion Receiver For Radio Amateurs, Pt.2; Spruce Up Your PC With XP-Style Icons.

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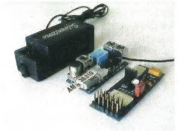

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continued on page 96

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Advertising Index

Acetronics 95
Allthings Sales & Services 95
Altronics 66-68, 95
Av-Comm Pty Ltd 95
Dick Smith Electronics 22-25
Elan Audio 83
Emona 9
Grantronics 94
Harbuch Electronics 71
Instant PCBs 95
Hong Kong Trade Council ..... IFC
Hy-Q International 79
Jaycar 45-52,95
JED Microprocessors 11,79
MicroByte Electronics 79
Microgram Computers 3
MicroZed Computers 79
Oatley Electronics 13
Printed Electronics 95
Procopy 79
Quest Electronics 79
RCS Radio 79,95
RF Probes 79
Silicon Chip Back Issues 92-93
Silicon Chip Bookshop 86-87
Silicon Chip TestBench ..... IBC
Silvertone Electronics 79,95
Soundlabs Group 79
Taig Machinery 95
Telelink Communications ... 79,OBC
Wiltronics 79

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